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ECONOMIC CONSIDERATIONS IN THE FORMULATION AND REPAYMENT OF CALIFORNIA WATER PLAN PROJECTS

Prepared for

THE JOHN RANDOLPH HAYNES
AND DORA HAYNES FOUNDATION

STANFO[...] ITUTE
[...]RK, CALIFORNIA

With the compliments of

THE JOHN RANDOLPH HAYNES
AND DORA HAYNES
FOUNDATION

March 1958

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A Report by Stanford Research Institute

S R I Project No. I-2300

Prepared for:

THE JOHN RANDOLPH HAYNES AND DORA HAYNES FOUNDATION

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FOREWORD

The Trustees of the Haynes Foundation have been aware of the importance of the problem relating to the development and utilization of water resources within the State of California. As the problem is of enormous complexity, the Trustees of the Haynes Foundation, consonant with their concern for problems affecting the public interest on regional and state levels, concluded that a comprehensive and objective study of one of the basic aspects of the total problem, namely, establishing economic criteria as a means of evaluating water projects, would be of value to the people of California in formulating policies for the optimum utilization of water resources within the State.

Because of the high standards of research to which Stanford Research Institute conforms, the Haynes Foundation made a grant to the Institute to undertake such a study, of which the following monograph is the result. As is traditional in its relation to recipients of its grants for research projects, the Haynes Foundation accorded complete freedom and independence to Stanford Research Institute in its investigation and study of this problem and in its formulation of the findings, recommendations and conclusions set forth in this publication. Accordingly, such findings, recommendations and conclusions do not necessarily reflect the views of the Trustees or staff members of the Haynes Foundation.

FRANCIS H. LINDLEY
President
The John Randolph Haynes and Dora Haynes Foundation

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Section I

INTRODUCTION

In accordance with the California Water Plan, the State of California is embarking upon a comprehensive program of financing, constructing, and operating a series of water resource development projects. The Feather River Project has been proposed as the first unit to be constructed under the Plan.

In the past, the development of water resources within the State has been undertaken either by various local public and private agencies or by the federal government. The purpose of the State's entry into this field is to coordinate and expedite the over-all development of California's water resources by supplementing (but not supplanting) the efforts of these other agencies.

The State of California has not yet adopted the economic and financial policies and practices that it will follow in formulating, evaluating, and operating its water projects. However, the State recognizes the need to establish policies and practices which will be proper and equitable, which will apply uniformly to all of its proposed projects, and which will permit and encourage the various local and federal agencies to continue their participation in the development of California's water resources.

Following discussions with State water officials, legislators, and various other interested individuals, The John Randolph Haynes and Dora Haynes Foundation concluded that it could serve the public interest by sponsoring a study which would be of use to the State in establishing economic and financial policies and practices relative to the formulation, evaluation, and repayment of projects to be proposed for consideration under the California Water Plan. Accordingly, in August 1957, the Foundation requested Stanford Research Institute to undertake a study of these subjects.

The scope of this study was intentionally broad, encompassing many matters that are complex and, in large part, controversial. At the same time, the study did not directly consider the assignment of water rights (i. e. , the so-called "Counties of Origin" question), the methods of financing project construction, or the question of State assistance to local projects. Although the water rights issue and the manner of State assistance to local projects were beyond the scope of this investigation, the formulation of economic and financial policies for State projects may aid substantially in resolving these problems. With respect to methods of initial financing, the study assumed that the State will obtain investment capital partly from current funds and revenues and partly from the sale of general obligation bonds, although the specific method of financing will have no particular effect on the policies and practices discussed in this report.

In conducting the study, the Institute held detailed discussions with representatives of the California Department of Water Resources, the State Legislative Analysts Office, various interested federal and local agencies, irrigation and water supply districts, municipal governments, and other organizations and firms closely associated with the subjects under examination or having pertinent experience. To the extent that time permitted, members of the Institute's project team attended legislative hearings on the matters under study and held discussions with individual legislators.

The personal views of a number of individual authorities were sought. This field work was conducted in Sacramento, the San Francisco Bay Area, the San Joaquin Valley, and Southern California. Organizations and agencies consulted during the study are listed in Appendix C. A major part of the study was devoted to a search of the pertinent literature, including that made available by the organizations and agencies contacted. The project bibliographical references are included as Appendix D.

Section II of this report contains the conclusions and a summary of the major findings of the study. Section III contains background information and a discussion of basic principles. Sections IV through VI are concerned with the formulation and evaluation of water resources development projects. The remaining sections deal with cost allocation, pricing and repayment, and marketing.

The Institute wishes to express its appreciation to the many agencies, organizations, and individuals throughout the State who so generously contributed their time to this work.

Research was conducted under the administrative direction of James R. Lee. Members of the project team included James H. Forbes, Jr., project leader; Dr. Robert W. Oliver; Lorenzo I. Dow, Jr.; Wesley L. Tennant; Charles B. Jones; and Betty J. Neitzel. Dr. Neil T. Houston provided technical assistance. Serving in a liaison capacity for the Haynes Foundation during the research program were Dr. Arthur G. Coons, Chairman of the Research and Grants Committee, and Mr. Paul Fussell, Vice President.

Section II

CONCLUSIONS AND SUMMARY

Conclusions

The following general conclusions can be drawn from this study:

1. An appropriate State policy for water resource development will seek to allocate remaining unappropriated water resources in such a way as to maximize the net economic benefits to society; this objective requires that the beneficiaries of the program assume substantial responsibility for the repayment of the public investment.

2. To avoid uneconomic expenditure of public monies, there must be practical means of distinguishing between good and poor investments and of selecting the most economically desirable of alternative investment proposals; appropriate economic and financial guidelines and policies must therefore be established by which State projects can be formulated and evaluated properly.

3. Until such guidelines and policies are established, the prices at which the State will sell water will not be known and the State therefore will be unable to estimate with a reasonable degree of precision the quantities of water it might be able to sell, or to assess the absolute and relative economic desirability of alternative project proposals.

4. In selecting methodologies for the formulation and evaluation of water projects, it will be desirable that the State adhere to federal precedents insofar as it is appropriate to do so; it would seem necessary that the State depart from federal custom, however, in a number of instances in which specific federal practices appear deficient for State purposes or otherwise reflect objectives that are inconsistent with those of the State.

5. It is important that economic and financial analyses be required as an integral part of the project formulation process, for these analyses are useful tools if applied during, rather than after, the preparation of project plans; if a project is not planned within the established economic frame of reference, there is danger that an after-the-fact evaluation will find that the project will not meet the tests of economic and financial feasibility.

6. If the State's water development program is to be pursued on sound economic and financial grounds, it is necessary that each individual project and each separate purpose of a multipurpose project be evaluated on its own merits; revenues or economic benefits attributable to one project or project purpose ought not to be applied as offsets to the costs of another project or project purpose in feasibility determinations.

7. If projects are formulated properly, project beneficiaries ought to be able to repay in full over the lifetime of a project the costs allocated to the particular features or purpose from which they benefit; to the extent that practical repayment arrangements can be established, sound policy requires that the State seek full reimbursement of its costs.

8. Repayment on a project-by-project basis seems generally preferable to repayment methods in which all or part of the costs of two or more projects are averaged together and for which costs the beneficiaries of those projects share repayment responsibilities; similarly, within a given project, the multipurpose nature of State projects suggests that groups benefiting from one project purpose not be required to assist in the repayment of another project purpose from which they do not benefit.

9. The broad geographical scope proposed for major State projects suggests that water repayment schedules be varied within a given project to reflect actual cost differentials in transporting water to different service areas.

10. It appears that the State may best recover these costs by dividing water charges into two parts: an annual fixed (or "capacity") charge covering capital cost apportionments, and a variable charge to cover operating and maintenance expenses incident to water deliveries.

11. By allowing each local public district contracting for water to retain the prerogative of obtaining repayment funds in any manner it chooses, the State would avoid becoming involved in matters of primarily local concern; a district might elect, for example, to meet its repayment obligations through revenues derived from the resale of project water, through general taxation within its boundaries, or through some combination of these methods.

12. In marketing water, the State likely will contract mainly with local public districts; in their present form, however, some of these districts may not be wholly adequate as repayment mechanisms for State projects, and the State may therefore wish to encourage the establishment of districts which can purchase and resell water for all beneficial uses, which can exercise general taxing power over all property within their boundaries, which can preferably be organized on a regional basis, and which will have an adequate and stable tax base to support long-term contract obligations.

<u>Summary</u>

The State of California intends to finance, construct, and operate those projects of the California Water Plan which are either outside the scope of interest or beyond the capabilities of local and federal water resource development agencies or of private enterprise. Presumably, the role of the State will be to augment and coordinate the efforts of these various agencies rather than to compete with them.

To ensure a wise use of resources, the State must adopt economic guidelines which express its views with respect to what does and does not constitute a sound water resource development project. There is also a need to adopt procedures which will ensure that projects are formulated within those guidelines. In public water resource development programs, economic and financial analyses have often been undertaken solely as a means of "justifying" project proposals which have already been fully formulated. Such analyses are useful tools only if applied during, rather than after, the formulation of a proposal, and their use in justification ought to be incidental. Moreover, if a project has not been planned within an established economic frame of reference, there is danger that an after-the-fact evaluation will find that the project is not economically desirable.

Establishment of the fact that an economic demand exists for water is in itself insufficient to justify construction of a given project. There must also be adequate assurance that the economic gains to be derived will exceed the economic costs, that the financial costs deemed recoverable from beneficiaries will be repaid from project revenues, that the particular project proposal is the most economically desirable of the practical alternatives available, and that the scope and scale selected for the project are more economic than would be the case if the project were either larger or smaller.

Applicability of Federal Precedents

In establishing economic and financial policies for the formulation and repayment of its projects, the State would do well to adhere to federal precedents insofar as they are appropriate. Those precedents are widely recognized and offer the State the practical advantage of employing common concepts and definitions in federal-state relationships. It would seem necessary to depart from federal custom, however, wherever federal practices reflect objectives that are different from those of the State. Bureau of Reclamation policies, for example, have historically permitted the sale of irrigation water below cost as a means to such ends as the disposal of public lands, the settlement of the West, and the promotion of "family-sized" farms. It is unlikely that the State today shares these same objectives. Also, federal projects have not emphasized supplying water for municipal and industrial use or the use of project facilities for recreational purposes. The California Water Plan, on the other hand, suggests that State projects will be multipurpose, with impartial emphasis on all project purposes (i. e., municipal and industrial water supply, irrigation water supply, flood control, recreation, etc.).

The Question of Subsidies

It is presumed that the fundamental objective of the State will be to achieve the most economic allocation of its water resources (i. e., an allocation that will maximize the net benefits to society), and a State

policy under which certain beneficiaries do not pay the full costs of the benefits they receive may be inconsistent with this objective. If subsidies are to occur, they should be either unavoidable or economically justified, and, in any case, clearly identified rather than hidden.

California is a political rather than an economic entity. Therefore, in the event that project subsidies are warranted, it may be more reasonable to ask groups within a given economic region to subsidize other groups within that region than to ask support either from persons in another economic region or from State taxpayers generally. Although the general taxpayers may be asked to underwrite projects by extending credit, underwriting is not the same as subsidizing.

In considering the subsidization of irrigation water, it is well to recognize that the farmers who do not now own the land in the project service areas will not derive benefit from such a program; they will have to pay a price to buy or lease land which will include the capitalized value of the water subsidy, and they will then be dependent on a continuing subsidy.

An Optimum Project

It is important to decide how much of the anticipated growth in total water demand should be provided for in each project. A project too small in capacity may soon be outmoded; one that is too large commits investment funds to facilities that may be partially idle for many years. Through interplay of economic and engineering evaluations, the objective should be to seek a project proposal that represents an optimum entity in view of its costs and the anticipated economic demands for its products and services.

The California Water Plan is not intended to be more than a broad engineering plan, based on a concept of maximum physical development. Planning thus far has been based on estimates of certain "ultimate water requirements" that are unrelated to prices, market conditions, or near-future economic demands. While these estimates have been necessary and useful in developing a broad outline for the California Water Plan, they are not the equivalent of market demand.

Estimates of the demand for project water should serve as the basis for specific engineering designs. The State will be unable to conduct proper water demand analyses, however, until it determines a range of probable prices for project water. Demand is an expression of the various quantities of a commodity that can be sold at various prices under given market conditions. Thus, for example, in those agricultural areas of the State in which construction of a federal irrigation project is an alternative to receiving water service from the State, the degree of popular support for State construction of irrigation projects cannot be determined until irrigators are able to compare State and federal terms. In turn, these State terms depend on policies concerning cost-sharing and repayment arrangements that have not yet been established.

Project Formulation

To assist project planners in achieving an optimum development by economic standards, a number of guidelines, concepts, and procedures have been evolved, principally through the experience of federal water resource agencies. Although there has been considerable criticism of the manner in which these procedures have sometimes been applied, the underlying principles that they express appear sound.

Benefit-cost analysis provides the principal means by which projects may be formulated and evaluated. Since there is often no financial objective in a public project other than that revenues be sufficient to recover certain costs, the merits of a project cannot be judged in terms of its financial revenues and costs alone. Benefit-cost analysis therefore serves the same purpose in formulating and evaluating a public project that revenue-cost analysis does in formulating and evaluating a private undertaking. (For example, where the objective in private enterprise might be to maximize net profit or rate of return on investment, the comparable objectives in a public project would be to maximize net benefits or the ratio of benefits to costs.)

Economic Benefits and Costs

"Primary benefits" are the values that the direct users of project commodities and services derive. "Secondary benefits" are values that accrue indirectly to persons other than the direct beneficiaries as the result of increased economic activity stemming from or induced by a project. "Economic costs," against which benefits are compared, include more than the financial outlay of the sponsoring government. They include financial expenditures incurred as well by other organizations, agencies, and individuals, together with the value of any detrimental economic effects (losses) expected to result from the project, no matter to whom these costs and losses might accrue.

Certain benefits and costs are of an intangible nature and cannot be reduced to money terms. While these intangible values by definition cannot be considered in the quantitative evaluation of a project, they may nevertheless be sufficiently significant to receive qualitative consideration.

The value of project commodities and services to primary beneficiaries is the basis of primary benefit measurement in federal practice. Some apparent inconsistencies arise in the methods used in estimating benefit values for different project purposes. With certain exceptions, however, the methods that are generally accepted in federal practice seem sound and appropriate for use by the State.

The identification and measurement of secondary benefits offer particularly difficult and complex problems, and their use in project evaluations has become suspect. For purposes of project formulation,

consideration of secondary benefits would seem necessary only in marginal cases, and even then qualitative evaluations would likely suffice. However, because secondary benefits can be measured with a greater degree of confidence when employed in local area evaluations, they may be useful in establishing (or justifying) local repayment districts which include indirect as well as direct beneficiaries.

Economic and Financial Analyses

A project may be regarded as economically feasible if the expected economic benefits exceed the expected economic costs; it is financially feasible if expected revenues at least equal those anticipated financial costs deemed recoverable from beneficiaries under established policies for cost sharing and cost recovery. Two separate and distinct tests of feasibility therefore exist. In the case of a multipurpose project, the tests should be applied to each of the separate purposes or functions of the project as well as to the project as a whole. Moreover, if the State's water development program is to be pursued on sound economic grounds, each project in a series of related or integrated projects ought to be evaluated on its own merits.

In general, the best single guide in the selection of the most economically desirable project or project component of a number of feasible alternatives is the greatest ratio of benefits to costs. Once initial selection has been accomplished, however, there is justification for adjusting the scope and scale of the selected project or project component so that the value of net benefits is maximized, even though this might tend to decrease the benefit-cost ratio.

Recognition of the Elements of Time and Risk

Forecasts of the anticipated economic effects of a project are subject to all of the risks of prediction. Moreover, anticipated benefits, revenues, and costs may not accrue at the same points in time, and these expected values can therefore be compared meaningfully only if they are adjusted to a common time base. This adjustment can be accomplished either by discounting all values to their present worth or by converting them to average annual equivalents. In either case, the adjustment is made by application of an interest (or discount) rate that provides a means both of recognizing the time value of money and of allowing for the risk of prediction. An appropriate interest rate to be used for this purpose would seem to be one that is somewhat higher than the interest rate applicable to long-term government borrowings. This discounting process results in an imputed interest charge on all project costs; thus, it makes little difference for purposes of economic analysis what the actual interest rate paid on capital funds to be invested in a project will be.

To minimize the risk of prediction, it has become customary in federal practice to establish specific time limits governing the maximum periods over which project effects may be considered for purposes of analysis and over which financial costs must be amortized and repayment by beneficiaries effected. Authorities generally recommend that both the periods of analysis and of repayment be no more than 50 years, measured from the time that the first benefits of a project are expected to accrue.

Cost Allocation

While certain elements of the cost of a multipurpose project can be identified with the individual project purposes, other elements of cost are incurred in connection with the over-all operation and cannot be identified with a particular project purpose. The former elements of cost are termed "separable costs"; the latter are termed "joint costs." The separable cost of a project purpose is the additional total cost of the project over what that total cost would have been if that project purpose had been excluded.

The establishment of cost-sharing responsibilities in public water projects requires that all costs, both separable and joint, be allocated in some manner to the individual project purposes. In addition, cost allocation provides a means by which the economic and financial aspects of individual project purposes can be analyzed and evaluated during project formulation. Finally, it provides a means by which the economic and financial performance of each project purpose can be audited and re-evaluated periodically after project operations have commenced.

A consideration of the basic economic and ethical principles involved indicates that an appropriate cost allocation method is one in which (1) costs allocated to any project purpose will at least equal the separable cost of that purpose, (2) the sum of the costs allocated to all project purposes will equal the total cost of the project, (3) total costs allocated to a particular purpose (as a basis for repayment) will not exceed the value of the economic benefits to be derived from that purpose, and (4) cost sharing is otherwise accomplished in a reasonable and impartial manner.

Of the many methods and many variations of methods that have been used to allocate costs in public water projects, the "separable costs-remaining benefits" method seems clearly preferable. In general, the method seeks to identify the separable costs attributable to each project purpose, and to distribute the residual joint costs among the various project purposes in proportion to each purpose's "remaining benefits" (i.e., its total benefits less its separable costs).

Repayment

While the cost allocation process may serve as a framework for repayment arrangements, the State must decide whether the costs allocated to each project purpose will be repaid by the beneficiaries of those purposes in full, in part, or not at all.

A requirement for full reimbursement would tend to prevent authorization of unsound projects, would minimize the general tax burden, and would largely eliminate the possibility of unjustifiable subsidies. Moreover, if projects are formulated properly on the basis of clearly identifiable direct benefits and reasonably accurate estimates of economic demand, the beneficiaries of each project purpose ought to be able to repay the costs allocated to that purpose.

The State may consider, however, that sufficient indirect benefit will accrue to the general taxpayers as the result of incorporating a particular purpose into a multipurpose project to make a contribution by the general taxpayers to that purpose worthwhile. For such reasons as the promotion of public health and safety, moreover, the State may consider that it has a social responsibility to share in the costs of a certain project purpose. Finally, there may be practical difficulties in obtaining full repayment from the beneficiaries of some project purposes. It may be either impossible to identify those beneficiaries for purposes of repayment or, if they can be identified, there may be no practical means of collecting from them.

Since it is the particular nature of the individual project purposes that might influence the State's decisions with respect to the reimbursability or nonreimbursability of costs, there would seem to be no logical basis for declaring nonreimbursable any capital costs, such as the costs of acquiring land and rights-of-way, that relate to a project as a whole.

Flood Control. In general, the federal government has not made an effort to collect substantial contributions from the direct beneficiaries of flood control projects, although federal disposition in recent years has favored requiring more rather than less local participation to secure project authorizations. In the case of federal projects located in California, most of the costs assigned to local interests for repayment have in fact been paid in their behalf by the State government. It is questionable, however, that the State will wish to follow this precedent in the case of its own flood control projects.

Although it can be argued that the State has a responsibility to protect lives and property by participating in the costs of providing flood control measures, the economic benefits by which these projects may be justified are largely private and local. Thus, as a minimum, municipalities and local flood control districts should be expected to contribute to the flood control costs of projects to an extent that is appropriate in view of their particular benefits, circumstances, and repayment capacities.

Other Project Services. As in the case of flood control, local repayment districts might serve as suitable cost recovery mechanisms for such project purposes as salinity control and pollution abatement. In the case of the recreational purposes of projects, it would seem possible for the State to effect recovery of a substantial portion, if not all, of its costs by assessing charges to the recreation industry through recreation districts established for the purpose, or by leasing land it may acquire in the vicinity of reservoirs to private recreational enterprises. The costs of incorporating project features intended for the enhancement of fish and game habitats probably must be regarded largely as nonreimbursable, although some contribution might be realized through licensing and other sports fees.

Hydroelectric Power Generation. It appears that the State will have no difficulty in recovering the costs allocated to the power purposes of State projects. But, while it is presumed that the State will sell its power at the highest possible price (giving preference to public agencies only in the event that public and private users offer to pay identical prices for equivalent contract provisions), the State may be faced with the problem of disposing of its "profit." If the State should follow federal precedents in this regard, surplus power revenues would be applied to the repayment of other project purposes (i.e., specifically, irrigation water supply). To do so, however, would result in a subsidy either by the general taxpayer (to whom all project revenues "belong") or, from another point of view, by the purchasers of project power (who, in effect, may be overcharged to make a subsidy possible). To retain the multipurpose character of State projects and to otherwise avoid subsidies, it would seem administratively preferable that surplus power revenues be consigned to a special water development fund for use in financing (but not repaying) future water development projects. When all feasible projects have been built, these funds would revert to the general fund of the State.

Water Supply Purposes. Because of historical distinctions, different methods of benefit measurement, and separate cost allocations, water to be supplied by State projects may be regarded as consisting of two distinct products: "irrigation water" and "municipal and industrial water." For these and other reasons, and irrespective of any State policy of subsidization, repayment requirements per unit of irrigation water in a given area may be less than those of municipal and industrial water.

In federal practice, irrigation water is heavily subsidized by the general taxpayer and by users of project power and municipal and industrial water. The interests of the State in supplying irrigation water, however, appear to be no different than in supplying municipal and industrial water, and these interests would seem to require full repayment of the costs (including interest) allocated to both of those project purposes. Because of a difference in basic objectives, it is

likely that any repayment policy that the State might adopt with respect to irrigation water will result in repayment terms that are less attractive to irrigators than the terms of the Bureau of Reclamation. This fact will have an important bearing on the degree of popular support for incorporating irrigation water supply purposes in State projects.

Alternative Approaches to Water Repayment

Just as it is preferable that projects be formulated, evaluated, and authorized on their individual merits, it would seem preferable, though not essential, that actual repayments also be effected on a project-by-project basis.

From the point of view of the State, however, it is only necessary that total repayments received from all projects be sufficient to repay the total reimbursable costs of all projects. It has been suggested in public discussions of the California Water Plan, for example, that costs be averaged so that all beneficiaries of all projects would bear equal charges. As each new project is added to this "utility" system, costs would be reaveraged and charges would be adjusted accordingly. A variation of this method would be to establish an f. o. b. pricing point, either actually or hypothetically, at the San Joaquin-Sacramento River Delta "pool." The costs of works required to deliver water to the pool would be averaged and apportioned equally among all water users. The additional costs of transporting water from the "pool," however, would be borne by the beneficiaries of each project.

Because there would be no assurance that costs assigned to a particular beneficiary group would not eventually exceed that group's benefits, these systems would likely force a redistribution of the available water from lower to higher uses, which would tend to increase total benefits to be derived from the water development program. But, as a practical matter, this would violate the historical approach to water development in the State which has been based on a maxim of firm water rights. Moreover, many projects of the California Water Plan may be wholly unrelated, and so separated in terms of both physical distance and time of construction as to make the logic of a utility pricing system questionable. Subsidies are also involved in any system based on an averaging of costs, and, also as a practical matter, it is unlikely that water agencies would be willing to sign, in advance of project construction, contracts which do not guarantee firm water rights and do not provide for the assessment of water repayments on the basis of known and simple formulas. Moreover, unless some means exists by which projects could be financed and authorized automatically, it is unlikely that the beneficiaries of early projects would, as general taxpayers, cast their votes in favor of constructing new projects from which they would not benefit but whose repayment costs they would be required to share.

Geographical Apportionment of Repayment Responsibilities

The broad geographical scope of the major projects envisioned by the California Water Plan suggests water repayment schedules that vary according to the costs of serving particular areas within each project. Consistency of method and soundness of procedure require, moreover, that this geographical apportionment of costs be accomplished in the same manner that costs are allocated by project purpose (i.e., by the separable costs-remaining benefits method). In computing costs allocable to a particular water supply agency, for example, the separable costs of servicing the district would be computed by determining the total cost of the project purpose with and without service to that agency. Joint costs, if any, would be assignable to that agency in proportion to the value of that agency's "remaining benefits."

Water Rates and Charges

It appears that the State may best recover all of the costs allocated to water and encourage the maximum use of its water facilities by dividing its water charges into two parts. The first part would be an annual fixed (or "capacity") charge, payable by the contracting agency even if it bought no water at all and covering all of the annual capital costs allocated to that agency. The charge would be fixed in the sense that it would not depend upon the amount of water actually used by the agency in any given year, although it might vary from year to year because (1) total capital costs are repaid in amounts which change (increase) each year over the lifetime of the project, or (2) because the share of the total annual capital costs allotted to any given agency might be revised to reflect changed conditions. Provision might also be made for the State itself to assume the obligation of repaying the fixed charge allocated to certain public water districts during some initial development period, providing the district agreed in turn to repay the State subsequently with interest.

The second part of the water charge would be a variable amount designed to cover the operation and maintenance costs of providing the water actually used by the contracting agency.

Other alternatives would seem less desirable. The State might market its water, for example, on a per-unit (acre-foot) basis, charging the water users a price designed to recover annual costs under conditions of full capacity operation. Such a policy would have the disadvantage, however, of causing bookkeeping losses until such time as full capacity operations were reached. Also, the State might attempt to set a price designed to cover all costs regardless of the level of operations. But such a price would be so high at the outset that (almost) no water would be sold. Another possibility is that the State might attempt to set a price which would remain unchanged over the lifetime of the project and still cover all the costs over this extended period of time. But such a price would necessitate forecasts that

probably would be impossible to attain in practice, and, like the other pricing policies mentioned, would discourage growth of water use in the early years of project operations.

A price designed to cover in the short run only those costs which vary with the quantities of water actually delivered would have the advantage of encouraging the maximum use of the facilities commensurate with recovering the variable costs, but it might cause the water provided by the State to displace, at least temporarily, the local water which the State project was designed to supplement rather than supplant. In addition, it would cause bookkeeping losses on the fixed costs until full capacity operations were reached. Unless the general taxpayers of the State are willing permanently to subsidize water users, moreover, it would also require the State to adjust its price upward, perhaps drastically and with unsettling economic consequences, after full capacity operations have been attained.

Marketing

It should be the prerogative of each local water agency to obtain the funds needed to repay the State in any manner it chooses. Thus, a public district might collect all the required funds by selling water to the water users of the district; it might collect all the required funds by taxation within the district; or it might (as it probably would) resort to some combination of these two approaches. Ideally, the secondary beneficiaries of the district would pay for their benefits through taxes, and the primary beneficiaries would pay for their benefits through both taxes and water prices. But the method of achieving this ideal in practice would be left to the local district rather than to the State.

There are over 2,800 public and private water agencies serving local areas in California. In its marketing program, the State will be primarily concerned with serving public districts authorized to acquire and sell water of which no less than 15 different forms exist. The individual districts vary widely in size, financial capacity, legal authority, and scope of interest. Certain of the districts are authorized to levy a general tax on all property within their boundaries, others may tax land only, and still others may levy assessments only against lands actually benefiting directly from water development programs or other conservation measures. Land use in some districts is largely urban in nature, in other districts it is rural, and in still others a mixture of urban and rural. There is apparently some question that certain types of districts could legally contract with the State for water that is intended for certain uses or that these districts could accept an allocation of cost incident to supplying water for those uses.

These conditions suggest that the State review the adequacy of existing water district organizations as repayment mechanisms for State water projects. Not only would the State find it cumbersome to contract with numerous small districts, but the limited repayment

capacity of many of those districts may well preclude their full participation in the benefits of the California Water Plan.

It would seem necessary that the State seek the establishment of districts which can purchase and resell water for all beneficial uses, which can exercise general taxing power over all property within their boundaries, which can preferably be organized on a regional basis, and which will have an adequate and stable tax base to support long-term contract obligations.

To help ensure that project undertakings are financially feasible and to protect the general taxpayer, it would seem necessary that contracting agencies and districts be obligated to meet payment schedules by means of contracts entered into in advance of construction as is the practice in federal projects. To secure such advance contracts, the State may be required to offer firm allocations of water to contracting agencies. It would seem reasonable that the basic contract period coincide with the project repayment period (say, 50 years). In the case of those individual districts which might qualify for special State assistance, the repayment period might be extended somewhat.

The most appropriate general form of contract would seem to be of the "water service" type, under which contracting agencies would receive a "water use" right and an option of perpetual renewal so long as they are not in default of contract. The nature of State projects suggests that title to the physical project facilities remain with the State.

Unlike typical federal agency contracts, State contracts should make some provision for revision of both capacity charges and operating and maintenance charges. These provisions would seem essential to reflect differences between actual and estimated capital costs, certain upward or downward revisions in capital cost allocations, and increases or decreases of operating and maintenance costs.

Section III

GENERAL CONCEPTS AND PRINCIPLES

According to the California Water Plan,[1/] the State of California has entered the field of water resource development in order to coordinate and expedite the activities of all agencies engaged in developing the State's water resources, and to finance, construct, and operate those facilities which are either outside the scope of interest or beyond the capabilities of other agencies. Thus, the State's Plan is based on the proposition that the future water requirements of the people of California will not be adequately met solely by the actions of federal or local agencies or of private enterprise, and that it is an obligation of the State to take specific action in furthering the development of its water resources.[2/]

Authority for the State to act in this regard is set forth in the State Water Code which specifies, for example, that

> . . . the general welfare requires that the water resources of the state be put to beneficial use to the fullest extent of which they are capable.[3/]

But the word "capable" has a number of implications. Should the term be understood in its engineering sense or in its economic sense? Does the statement imply that all the people of the State will benefit equally from a State-developed water resource program? Are the people of the State obligated equally to meet the costs of making additional water available? Does the State intend that water be included in the same category as public education in the sense that every citizen has a right to obtain water free of direct charge? Or at a price which he can afford to pay? Or at a price which covers the cost of making the water available?

It is apparent that if the State is to take a leading role in the future development of its water resources, it requires a frame of reference by which to judge the economic success or failure of its actions. Presumably, the State will wish to delineate its objectives and to adopt policies which will ensure that it acts in conformity with those objectives.

1/ Department of Water Resources, The California Water Plan, 1957 (Ref. 122). Note: All references are listed in Appendix D with complete bibliographic information. Short titles are used in the footnotes for convenience.

2/ For a brief history of water resources planning by the State of California, see The California Water Plan, pp. 23-28; and Banks, H. O., "Reorganization of the California Department of Water Resources," 1957 (Ref. 401).

3/ Water Code, 1955 (Ref. 173).

The State's Role with Respect to That of Other Agencies

An important question confronting the State is the role it will assume with respect to that of other agencies involved in the development of California's water resources. Pronouncements in the California Water Plan and elsewhere imply that the State will not regard itself as being in competition with federal or local agencies. Thus, this study assumes that if local water users prefer federal repayment terms, for example, and if federal funds are available, the State will itself advocate federal rather than State construction of a given project. It is also assumed that the State will not attempt to augment the water supplies of an area if that area is not utilizing (or planning to utilize) all the water supplies already available to it, or if other agencies could supply the additional needs of the area at a lower cost. 1/

The Extent to Which the State Should Follow Federal Precedents

Another question confronting the State is the extent to which it should follow federal precedents established in the field of water resource development. It would seem desirable, and perhaps even necessary, for the State to adhere to federal precedents where it is appropriate to do so, in view of the widespread recognition of those precedents and the practical advantage of employing common concepts and definitions in federal-state relationships. There are, however, logical points at which State policies and practices should depart from federal custom. These points occur whenever federal precedents reflect objectives that are inconsistent with the objectives of the State.

It is important to recognize, for example, that the sale of irrigation water at prices covering costs has never been an objective of the federal government. The sale of irrigation water below cost has been regarded instead as a means to such federal ends as the disposal of public lands, the settlement of the West, and the promotion of "family-sized" farms. 2/ Bureau of Reclamation policies have their origin in the Homestead Act of 1862, which granted 160-acre parcels of land to settlers agreeing to live on and develop the tracts. Other early federal legislation sought to stimulate irrigation farming by offering various inducements to settlers. Two of the principal objectives of the sponsors of the Reclamation Act of 1902 were

> . . . to prevent monoply of water on reclaimed public lands and to break up existing monopoly on private land by denying water to it. 3/

1/ For a discussion of the subject as it applies to Southern California, see The RAND Corporation, A Brief Survey of the Technology and Economics of Water Supply, 1955 (Ref. 51).

2/ For a discussion of the over-all objectives of federal water resource development, see The Report of the President's Water Resources Policy Commission, Vol. I, 1950, pp. 57-64 (Ref. 239).

3/ Taylor, P. S., "The Excess Land Law: Execution of a Public Policy," 1955, p. 484 (Ref. 381).

Recalling the early history of reclamation, the Bureau of Reclamation similarly stated in its 1942 Handbook that

> . . . the purpose of the original Reclamation Act of 1902 [was] to provide the maximum number of settlement and employment opportunities by the construction of irrigation systems in arid regions of the United States. 1/

These historical objectives have continued to serve as the foundation of present-day reclamation policy. In spite of controversy, a limit of 160 acres generally remains on the amount of land under single ownership which may receive water from federal irrigation projects. 2/ Federal irrigation water continues to be supplied below cost; it is heavily subsidized by the national taxpayer, by users of project power, and by users of municipal and industrial water.

It is questionable that the State of California shares the objectives of the federal government in furnishing irrigation water. To a greater degree than in most states, agricultural enterprise in California is characterized by large-scale, mechanized operations involving sizable land holdings and highly industrialized methods. Indeed, for this reason, the State has consistently opposed the 160-acre limitation in connection with irrigation water supplied by the Bureau of Reclamation.

A review of federal practices indicates that the primary function of a Bureau of Reclamation multipurpose project is to supply irrigation water for purposes of land reclamation even though it may also provide, in the manner of a by-product, other services such as flood control, navigation improvement, and water for municipal and industrial use.

1/ Margolis, J., "Economic Criteria for the Allocation of the Public Budget Benefits-Costs Measurements as a Case Study," 1955, p. 36 (Ref. 493).

2/ A 1912 modification of the original Reclamation Act required that farmers receiving federal water forfeit to the United States irrigable lands in excess of 160 acres. An extension of the Act in 1914 modified this requirement to permit landowners to sell lands that the Secretary of the Interior deemed to be in excess of an area sufficient to support a family. The Omnibus Adjustment Act of 1926 re-emphasized the "family-sized" farm concept by restricting deliveries of water to those amounts necessary to irrigate no more than 160 acres per ownership; sales prices of excess lands were to be regulated by the Secretary of the Interior as an anti-speculation measure. From time to time the limitation has been waived for certain projects. Also, because of California community property laws, a husband and wife are permitted to hold 320 acres. In certain recent project proposals, a farmer's entire acreage would receive water, but the subsidized price would apply only to that amount of water required to irrigate 160 acres.

The modern multipurpose concept of river basin development evolved, in fact, from the necessity of finding means of helping to pay for irrigation development. And, just as the historical role of the Bureau of Reclamation has been to supply irrigation water, the historical role of the U. S. Corps of Engineers in connection with the development of water resources has been to provide flood control and navigation improvement.

The federal government has never regarded the supplying of water for municipal and industrial use as a federal responsibility, nor has it placed particular emphasis on those project services (e. g. , the provision of recreational facilities) which it considers to be primarily of local rather than national interest. Both the California Water Plan and the State Water Code, however, indicate that the State's interest in water resource development is broader than that of the federal government, and that it accords approximately the same degree of emphasis to each of the several purposes which multipurpose projects may serve. Therefore, before the State adopts specific policies and practices of the various federal water resource agencies, it should decide whether or not it shares the particular objectives of those policies and practices.

The Concept of "Ultimate Development"

The California Water Plan is defined as

> . . . an ultimate plan, one that will meet the requirements for water at some unspecified but distant time in the future when the land and other resources of California have essentially reached a state of complete development.

In considering future water needs of the State, it should be remembered that the availability of water is but one of many factors which will influence the development of the State, and that insofar as water is an influencing factor, the cogent and relevant question is "whether the productive value of the water made available will justify the mounting costs of its development."[1/] In other words, it is the cost of the water rather than its availability that is significant. What must be discovered is whether the people who will put additional amounts of water to beneficial use are in fact willing and able to pay the additional and increasing costs of obtaining it. If they are not, there is strong presumption that the cost to society of the additional water is greater than its value, and that society would be better off if the additional water were not developed at all. This problem is one of resource allocation, the economics and implications of which are discussed below.

1/ Thompson, W.S. , Growth and Changes in California's Population, 1955, p. 289 (Ref. 73).

The Economic Allocation of Water Resources

It is presumed, for the purposes of this study, that the fundamental objective of the State's action in the field of water resource development is to achieve the most economic allocation of water, in other words, to maximize the net benefits to society of the development of the State's water resources. But this is a complicated subject which requires further elaboration.

Like food and housing, or like petroleum and timber, water is generally scarce relative to the demand for it. It is an "economic" as distinguished from a "free" good, and consequently must be allocated among users in some manner.

The problem of water allocation is complicated by the fact that water is useful in many ways for human consumption, for domestic purposes other than human consumption, for industrial purposes, for the removal of domestic and industrial wastes, as a home for fish and other aquatic life, for recreation and transportation, as a source of power, and for the irrigation of plants. Thus, water must be allocated among alternative uses as well as users.1/

The problem is further complicated in that water is not always available in sufficient quantities at locations where people want to use it, and the facilities for storing and transporting water require resources which in their turn might be put to beneficial use in an alternative manner. In other words, the cost2/ of making water available where it would not otherwise be must be taken into account along with alternative uses and users, if it is to be allocated in the most beneficial way.

From the standpoint of economics, water is not fundamentally different from any other resource which is both useful and scarce; the same economic principles which apply to the allocation of, say, petroleum

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1/ Fortunately, however, the problem is not one of satisfying all of the requirements for water in one use and none of the requirements in another. It is a problem, rather, of deciding between a little more water in a given use rather than in another. In technical language, it is a problem of water allocation at the margin.

2/ Cost refers to the using up of a resource (including human energy) which might have been used in an alternative way for human benefit. A cost may be thought of as a negative effect; it is an effect which, in and of itself, reduces human welfare even though it may result in a product which increases human welfare. People usually speak of cost in terms of dollars and cents, but when they do they are talking about the money value of the real cost.

and timber apply, or ought to apply, to the allocation of water. 1/ This is not to ignore the realities of, for example, principles of engineering design, intricacies of water law, and political considerations. It is to suggest, however, that the problem of water allocation is primarily an economic one and should, insofar as possible, be solved in conformity with economic logic. 2/ Ideally, water should be allocated so that the resulting increase in benefits (real income) exceeds the resulting increase in cost by the greatest possible amount.

In the private enterprise sector of the American economy, resources are allocated by the impersonal forces of the market. The premise in private enterprise is that the net benefits of society tend to be maximized by the market. The allocation of resources tends thereby to be guided by the wishes of individuals (consumers) who, presumably, know better than anyone else how to maximize their own benefits. 3/

In the government enterprise sector of the American economy, resources cannot always be allocated by the market. Indeed, it is a function of government to provide those goods and services which, although they are of direct or indirect benefit 4/ to virtually every member of society, either cannot be sold to beneficiaries as vendible commodities (e. g. , national defense) or would be of considerably less over-all benefit to society if they were sold as vendible commodities (e. g. , public education).

1/ It has been observed that: "Many intelligent laymen who think rationally in terms of the best use of land, or the development and provision of natural gas, or petroleum, or electricity, are apparently willing to abandon economic analysis when it comes to questions of water development."--Milliman, J. W. , "An Economist Looks at State Water Planning," 1957 (Ref. 440).

2/ As a scientific study, economics is concerned with explaining how scarce resources are allocated among competing ends. As a social study, economics is concerned with increasing human welfare or well-being.

3/ This generalization leaves out of account the question of income distribution. In all that follows, however, it is assumed that the redistribution of income per se is not a proper objective of a government water development project.

4/ Benefits are an increase in human welfare, well-being, etc. A benefit is a personal and subjective thing; that which benefits one person need not benefit another, either at all or to the same relative degree. While there is no way of measuring benefits on any absolute scale, intra-personal benefits can be compared if it is assumed that when a person spends a given amount of money he expects to receive at least as much benefit from using that thing he buys as he could receive from anything else requiring an equivalent expenditure. Furthermore, if by the exercise of its free choice society spends a given amount of money on something, it can be said that society receives a benefit which has a money value at least equal to the amount of money spent. The concept of benefits will be discussed in detail in Section V.

Occasionally, of course, government enterprise may undertake to provide a product which is of benefit to users in so direct and identifiable a manner that it can be marketed as a vendible commodity even though it probably could not be marketed profitably by private enterprise—either at all or at a price sufficiently low to be "in the public interest."1/ Thus, most state governments attempt to pay for their highway programs, at least in part, by a charge against highway users; many local governments sell water and power; and the federal government charges for the services of the post office. When government does go into "business" in this sense, moreover, it generally expects to recover a portion if not all of its costs through the sale of the product or service. In other words, it is presumed that the costs of production should be borne at least to some degree by the direct beneficiaries of the product or service.

On the other hand, most of the products and services made available by government (police and fire protection, national defense, public education, the administration of justice, etc.) are paid for by the people collectively through taxes. Moreover, while it is presumed that the benefits received by taxpayers collectively have a value at least as great as the value of the taxes paid, taxes are not, and cannot easily be, collected on the basis of individual benefit received. They are, for example, collected on the basis of property owned or goods purchased or ability to pay.

1/ This may be because government is more willing than private enterprise to compute depreciation over a relatively long period of time and to charge, on that account, a commensurately lower price—a consideration which is particularly important in the case of such long-term assets as highways, canals, dams, and aqueducts. In general, government may be more willing than private enterprise to accept a rate of return on investment which inadequately discounts the risk of the undertaking. It may also be that, in addition to the direct beneficiaries and purchasers of a particular good or service, a substantial portion of society benefits indirectly and is therefore willing to help bear the costs of making available the necessary resources.

It is pertinent in this connection to recall the dictum of Adam Smith regarding the duty of government beyond that of administering justice and providing for common defense: "The third and last duty of the sovereign or commonwealth is that of erecting and maintaining those public institutions and those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature that the profit could never repay the expense to any individual or small number of individuals, and which it therefore cannot be expected that any individual or small number of individuals should erect or maintain."—Smith, A., The Wealth of Nations, p. 681 (Ref. 65).

In principle, there can hardly be a clear distinction between those products of government which should be paid for entirely by the direct beneficiaries and those which should be paid for by taxpayers generally. Presumably, however, it is possible to distinguish between products in terms of the extent to which their costs can be assigned to a particular group of beneficiaries. Such a distinction would depend on such factors as the number of people who benefit directly, the number of people who benefit indirectly, the extent to which the direct and indirect benefits can be measured, and the relative values assigned respectively to direct and indirect benefits.

There may be some government products whose indirect benefits are so widespread and so great that it is economically sound for all of the members of society to join in paying for them. On the other hand, there may be a product which is of substantial and reasonably measurable direct benefit to a clearly identifiable group of people and of relatively small indirect benefit to a relatively small number of people. A product of this sort should probably be paid for by the direct beneficiaries.

It is one of the purposes of this report to investigate the question of who should be obligated to pay for the water development programs sponsored by the government of the State of California, and the issue need not be prejudged here. Certainly, it may be presumed that the government of the State would not be undertaking a water development program if the identical cost-price principles which guide the allocation of resources by private enterprise were to be followed. At the same time, as will be explained in more detail in Section IV, the anticipated benefits of water resource development should be taken into account and compared with anticipated costs, for anticipated benefits may serve in lieu of the anticipated revenues which are compared with anticipated costs in the formulation of a private enterprise project. To this extent, the market mechanism can tend to guide the allocation of resources in the case of government as in the case of private enterprise. Indeed, at least conceptually, the benefits of any government project or program should equal or exceed the costs, for if the costs exceed the benefits, the welfare of society is diminished.

The Question of Subsidies

One of the most difficult of the policy decisions confronting the State in connection with implementing the California Water Plan is the extent, if any, to which deliberate subsidization will be involved, for subsidization may be inconsistent with the objective of maximizing the net benefits of society.

For the purposes of this study, a subsidy may be defined as a grant of funds or property from a government to a private person or company. Thus, a person is being subsidized whenever he receives from government a product for which he pays, either directly or indirectly, less than it has cost to produce.

In this sense, almost everyone is subsidized at one time or another, and it would be erroneous to contend that subsidies are never in the public interest. But the burden of proof should be upon the person who desires to be subsidized. Unless the redistribution of income is an objective of government policy, persons other than those directly benefiting from a government project should not be asked to pay for it unless it can be clearly shown that they derive enough indirect benefit to make a subsidy worth their while.[1]

By these standards, it is unfortunately a good deal easier to define a proper subsidy than to identify one. Indeed, as will be demonstrated in the remainder of this report, it may be difficult to identify a subsidy whether proper or not, for the identification of the costs, benefits, and beneficiaries of a government enterprise is arbitrary at best. The proper relation between price and benefit may also be in dispute. Thus, for example, in the case of the California Water Plan, many subsidies are possible and some may be inevitable: water users may be subsidized by power users; the beneficiaries of flood control may be subsidized by both water users and power users; the water users of 1975 may be subsidized by the water users of 1995, or vice versa; and all may be subsidized by the general taxpayer who gives up more in the form of taxes than he receives in benefits. Nevertheless, if subsidies are to occur, they should be unavoidable, or economically justified, and be clearly identified rather than hidden.

Inter-Regional Subsidization

An argument frequently offered in support of a subsidized water program is that all of the people of the State will benefit from the subsidy. It is important, in connection with this argument, to remember that the State of California is a political, not an economic, unit. There is no single water project which will benefit all the people of the State equally. Certainly, the project which benefits (most of) the people of San Diego need not of necessity benefit equally, or even at all, (most of)

1/ It is a principle of welfare economics that the welfare of society may be increased if the people who benefit by a government action could (do) overcompensate the people who lose and remain better off than before. But the welfare of society is decreased if the people who benefit by government action cannot (do not) compensate in full the people who lose and remain better off than before. Thus, the danger of a subsidy is that the subsidizers will give up more than they receive in benefits, and their net loss cannot be (will not be) compensated for by the net benefits of those who are subsidized. Actually, this is just another way of stating the proposition that benefits should exceed costs. The requirement that the beneficiaries can (do) compensate any who are injured is an effective test of the proposition that benefits do exceed costs.

the people of San Francisco. The project which benefits (most of) the farmers of the San Joaquin Valley need not of necessity benefit equally, or even at all, (most of) the industrial workers of Los Angeles. Indeed, the farmers of the Imperial Valley might well derive more economic benefit from an increase in income in the State of Arizona than from an equivalent increase in income in the north coastal area of the State of California.

The point that the State of California is a political, not an economic, unit is important in any evaluation of whether a proposed subsidy is justified. The case for a subsidy depends on whether it is worth the while of indirect beneficiaries to pay the difference between the cost of a product and the payments of the direct beneficiaries. But it should be remembered that indirect benefits, if they exist at all, spread out like the ripples in a pool, and become less important the farther away they get, economically speaking, from the center. Thus, for example, if the people of the San Francisco Bay Area are asked to subsidize the people of the San Joaquin Valley, it should be shown that the people of the Bay Area would benefit more by subsidizing the people of the San Joaquin Valley than they would benefit if they spent an equivalent amount in an alternative way, including the development of productive facilities within the Bay Area itself.

This is not to deny that some of the people of the State may benefit indirectly from a program which is of direct benefit to another group of people within the State. But, if a subsidy is warranted, it may be more reasonable to ask the indirect beneficiaries in a given economic region to subsidize the direct beneficiaries of that region than to ask support from either the indirect beneficiaries located in another economic region or the general taxpayers of the State as a whole. If all the taxpayers are asked to subsidize the beneficiaries, they should be aware of the request and have some understanding of the extent to which they will benefit.

Although the general taxpayer of the State of California will underwrite (or finance) State water projects, underwriting should be distinguished from subsidizing. The general taxpayer (i. e., the State) will finance the necessary water facilities either by advancing his own funds directly (i. e., tax proceeds) or by borrowing (i. e., selling general obligation bonds), and then relending to the beneficiaries who repay him in whole or in part over the economic lifetime of the project.

Aid to Farmers

Unfortunately, the question of aid to farmers is complicated by the fact that a clear distinction is seldom drawn between assistance to individual farmers (or to local farm areas) and support of agriculture as an industry. It may be possible to make a case for a government program which assists farmers in some manner on an individual or localized basis. But efforts along these lines should be distinguished from programs which subsidize agriculture as an industry on a state-wide basis.

In any event, the provision of irrigation water at less than cost may act only to increase land values without benefiting farmers as farmers. To some extent, of course, individual farmers are also landowners, and they will benefit from this initial appreciation in land values by realizing a higher sales price if and when they dispose of their land. Nevertheless, a very substantial portion of the agricultural land to be served by contemplated State water projects is not owned by farmers. To the extent that this is true, a subsidy program would not aid farmers at all. But the primary point is that, over a period of time, as farm land is bought and sold, the farmers who own or rent the soil will not be the people who derive the benefit from low cost water; <u>they will have paid a price for their land or for their lease which includes the capitalized value of the water subsidy, and they will then be dependent on a continuing water subsidy in order to sustain the existence the subsidy was originally designed to improve.</u>1/

In connection with the question of special assistance to farmers, it must also be remembered that the structure of economic activity which exists at any given moment of time need not be the optimum structure at any other given moment of time. For many years, agriculture has been an important economic activity of the State of California, but there is no necessary <u>economic</u> reason why this should continue to be so. California has been an agricultural State because the resources of the State relative to the resources of the rest of the country and the rest of the world have been such as to make agriculture relatively profitable here. But as the relative scarcity of resources changes over the future, the economic growth of the State may follow new lines.

From the point of view of the entire State no adjustment to natural changes in the relative costs of resources need be regarded as undesirable. If it would be uneconomic in the long run to force the factors of production to enter agricultural rather than industrial pursuits, it would also be uneconomic, by means of a subsidy, to induce the factors of production to remain in agricultural pursuits. It is simply a matter of using the available resources in the manner most desirable economically.

1/ As a practical matter, the value of farm land in many areas of the State may have already risen in anticipation of new low cost water supplies. But it is far from clear that it is the duty of the State of California to underwrite the gains of land speculators.

Section IV

PROJECT FORMULATION

If the State of California is to ensure that its water development projects represent a wise use of resources, economic guidelines must be established which express, in advance of the formulation of project plans, the State's views with respect to what does and what does not constitute a sound water project. There is a corollary need to adopt policies and procedures which will ensure that projects are formulated within, and not independent of, those guidelines.

This section of the report is concerned, therefore, with the manner in which a project is defined for purposes of economic analysis and with the related policies and practices which might guide the formulation process. 1/

The Economic Definition of a Project

The federal Bureau of the Budget has defined a public water resource development project in the following manner:

> 'Project' means any integral physical unit or several component and closely related units or features, or any system of measures undertaken or to be undertaken within a specified area for the control or development of water or related land resources, which can be considered as a separate entity for purposes of planning, evaluation, financing, construction, management, or operation. Separable units or features will generally be considered as separate projects. 2/

The significant consideration in the definition is whether a particular physical unit can or cannot be regarded as a separate entity for purposes of economic analysis. Does the Feather River Project constitute

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1/ Presumably, the State Legislature will establish economic guidelines, but it has not yet done so. Studies are currently being undertaken by the Subcommittee on Financial and Economic Policy for State Water Projects of the Joint Committee on Water Problems. The Department of Water Resources has developed a number of tentative procedures. See Bulletin No. 59: Investigation of Upper Feather River Basin Development, 1957 (Ref. 123).

2/ Circular No. A-47, 1952, pp. 2-3 (Ref. 179). The California Department of Water Resources has tentatively adopted a similar definition. See Banks, H. O., "Statement to the Subcommittee on Financial and Economic Policy for State Water Projects," 1957 (Ref. 404).

a single project for purposes of economic analysis, or is it in reality a series of related projects? Can (or should) the Feather River Project be evaluated as a whole, or must it be evaluated in terms of its several components? Is a project the smallest component that is feasible from an engineering standpoint, or is it something larger?

A review of the California Water Plan leads readily to the conclusion that it constitutes a long-term program extending over many years. But it is not clear whether such major elements of the Plan as the Eel River and Feather River projects should also be regarded as broad programs rather than as "projects," with their separable components designated as projects for purposes of evaluation (and justification). The economic and financial feasibility of the Feather River Project, for example, as that undertaking is currently conceived, depends largely upon such a determination.

The California Water Plan is not intended to be more than a broad engineering plan, based on a concept of eventually developing all "the waters of California to meet present and future needs for all beneficial uses and purposes in all areas of the State to the maximum feasible extent." Thus, the Plan is intended to be one of maximum development, and not necessarily an optimum one by economic standards. The Plan recognizes the probability that many of the projects envisioned will require physical modification as each is subjected to economic and financial analyses prior to authorization. Yet, the Feather River Project, which is also based on this concept of maximum physical development, is entering the final stages of planning. The scope and scale presently selected for the Feather River Project may represent an optimum situation <u>by economic standards</u>, but economic and financial analyses have not as yet been undertaken to determine whether or not this is true.

There is, in fact, a basic and significant conflict between the objective of maximizing, say, the physical potentials of a given dam site and the objective of utilizing resources in their most economic manner. The two objectives are not the same and their compatibility in a given application would be coincidental. Economic principles require that the size and capacity of a water supply reservoir, for example, be closely related to that needed to supply the expected economic demand for the water and, further, that the cost of creating the reservoir be no greater (and preferably substantially less) than the economic benefit to be derived from use of the water.

It is important to decide how much of the anticipated growth in demand should be provided for in each construction step or project. A project too small in capacity and scope in relation to the need for its products and services may soon be outmoded, later necessitating costly modification or the construction of duplicate facilities. A project too large in capacity and scope commits investment funds to facilities that will be partially idle for many years, when these funds might better have been used for other purposes while water and related needs are developing.

The size and capacity of water supply works, for example, must be closely related to the forecasted growth in water demand. Although it may be prudent to provide some excess capacity to reduce long-term costs and to allow for future growth, a project should nevertheless be expected to reach full utilization within a reasonable period of years. Allowances for future expansion can be provided largely through a flexibility in design that will permit incremental increases in capacity if and when the need arises, or through later construction of additional projects. In this manner, the capacity of each project will be effectively and economically utilized, and investment risk will be minimized. Throughout the project formulation process, the objective ought to be one of achieving a practical optimum through a continuous interplay of economic and engineering evaluations. Although a necessary eventual goal may well be to achieve maximum utilization of all of the State's natural water supplies, economic considerations suggest that such a full development be approached in a series of individual steps or projects, with each project concerned with meeting more immediate, rather than eventual, needs.

The remainder of this section is devoted to an examination of various policies and practices by which State projects may be formulated so that, insofar as possible, each project represents an optimum economic entity in view of its costs and the anticipated economic demands for its products and services.

The Purpose of the Formulation Process

The purpose of the formulation process is to determine whether or not, in view of probable benefits and costs, the construction of physical facilities is in fact warranted and, if so, to indicate which engineering design will most effectively utilize the resources to be committed to the undertaking.

A basic criticism of public water resource development is that economic and financial aspects are usually ignored in the project formulation stage. Too frequently, economic and financial analyses have been undertaken after the fact, largely for the purpose of justifying, or attempting to justify, projects that have not been formulated within an established economic and financial framework. For this reason, economic andfinancial evaluations have often been abused, and their value as practical and reliable tools of project formulation has thereby been depreciated. 1/

1/ The economists' viewpoint in this regard has been expressed as follows: "The economist has yet to be admitted as an equal partner in the project formulation process. Rather he seems to be limited to justifying and checking on decisions already made. All too often the economist is expected to rationalize existing decisions rather than to explore the problem in its entirety. As long as basic economic questions are given scant treatment, our public water projects will be candidates for the serious criticism of failing to make best use of our economic resources."--Milliman, J. W., "An Economist Looks at State Water Planning," 1957 (Ref. 440).

Although economic and financial evaluations may serve to explain and to clarify a proposal, project justification should not be their sole, or even their most important, purpose. Properly accomplished and utilized, such evaluations are an essential part of the formulation process and their use in project justification is incidental.

A number of economic guidelines and planning procedures have gained recognition and acceptance over the years, largely through the experience of the federal government. 1/ Although there has been considerable criticism of the manner in which these have been applied, few economists find fault with the basic concepts and principles on which they are based. In essence, these guidelines and planning procedures seek to extend to public investments, insofar as possible, the same general line of reasoning long followed by private enterprise in making capital investments. Because of differences in terminology and viewpoint, this similarity is often obscured.

Assessment of Need

Demand for Project Water

There is little point in planning the construction of public water supply facilities until and unless the nature and extent of the need for the project have been defined and measured. 2/

Economic demand is an expression of the various quantities of a product that can be sold at various prices and under given market conditions. It is not a "requirement" or "need" computed without regard

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1/ Although practices are not identical among the principal federal agencies involved in water resource development (i. e. , the Bureau of Reclamation, the U. S. Corps of Engineers, the Department of Agriculture, and the Federal Power Commission), there nevertheless has been a trend toward standardization in recent years as a result of study and recommendation by congressional committees, professional and academic associations and societies, and special inter-agency commissions.

2/ This necessary first step has often been overlooked. The State of California has criticized federal programs for failure in this regard: "Concerning technique, the principal Federal water resources agencies, in their enthusiasm for projects, have frequently indulged in excessive planning prior to adequate investigation. Project plans have been fully developed before need for projects has been established. In some instances, construction itself has been initiated before it has been determined that required water supplies are available or that supplies when developed can be marketed and utilized. Again, numerous examples of this nature may be cited from California's experience in Federal water resources projects." --Views of the State of California on Elements of a National Water Resources Policy, 1950 (Ref. 101).

to either price or market conditions. As the price of a product increases, moreover, the quantity that can be sold generally decreases, and vice versa. Indeed, the quantity of project water that can be sold at one price may be far different from the quantity that can be sold at an appreciably different price.

Water demand studies have not as yet been undertaken in connection with the proposed Feather River Project or other projects contemplated by the California Water Plan. Planning thus far has been based largely on a "water requirements" concept and not on estimates of market demand. Water requirement computations, published in the State Water Resources Board Bulletin No. 2, are estimates of the quantities of water deemed necessary to support the expected future economies of the various service areas under conditions of "ultimate" development (i. e. , "conditions after an unspecified but long period of years in the future when land use and water supply development will be at a maximum and essentially stabilized"). 1/

While this approach has been useful in developing a broad outline for the California Water Plan (as well as having served other purposes) the "requirements" data, which were computed without reference to probable water cost, should not be construed as wholly indicative of market demand for water supplied by specific projects. 2/ Thus, an essential step in project planning has not yet been taken with respect to

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1/ Water Utilization and Requirements of California, Vol. I, 1955 (Ref. 167).

2/ Professor Milliman has commented as follows on this aspect of the California Water Plan: "Economists have criticized both the concept of 'ultimate' and the concept of 'requirements' as having little economic meaning. Who can specify 'ultimate' water use at some vague future date when all we can be sure of is that economic changes are certain to take place. The so-called 'requirements' were computed by assuming the price of water to be zero or irrelevant. By this method one could compute the irrigation needs of the Sahara Desert, but the result would not be very meaningful in itself . . . State water officials . . . point out that 'economic and financial tests must be made for each project of the Plan as the projects are proposed for construction' and that the Plan does not attempt to do this. While this reply is a valid one , it is to be recognized that it merely supports the viewpoint of economists that the 'requirements' set forth in the Plan have little or no relation in themselves to present or expected economic demands for water."—Milliman, J. W., "An Economist Looks at State Water Planning," 1957 (Ref. 440).

In its review of Feather River Project plans, the Bechtel Corporation similarly noted that water requirements schedules were not based on considerations of market demand: "It is imperative in project planning . . . to have the best possible estimates of probable water deliveries and probable water prices. Unfortunately, the Feather River Project report does not reflect an analysis of these

the Feather River Project or other projects contemplated by the California Water Plan. At the same time, realistic estimates of the quantities of water demanded cannot be made until probable water prices are forecast, and the determination of water prices must await decisions as to policies to be followed in cost allocation, cost repayment, and related matters. Only after these basic decisions have been reached can reliable estimates of market demand follow. 1/

Market demand for project water ought to be assessed early in the formulation process, after a range of probable water prices to consumers has been determined on the basis of established cost sharing and cost recovery policies, but before the preparation of detailed engineering plans. Demand estimates should serve as the general basis for refining engineering designs.

In evaluating probable water demand, economic studies undertaken within each potential service area should seek to determine:

1. The nature and extent of the current demand for water.

2. The manner in which the area can be expected to develop in the future and the rate and extent of that development in terms of population size and economic activity (taking into account any limiting effects, including the total supplies of water—and the quality and cost of that water—that can reasonably be expected to be made available to the area from whatever sources).

3. The probable rate and extent of growth, if any, in local demand for water, based on estimates of future economic development and trends in water usage (taking into account possible technological developments that might result in either an appreciable increase or decrease in water use).

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subjects. This creates uncertainty as to the desirable size of project features, the time schedule of construction, and the financial outcome. . . The study of demand for any product includes consideration not only of the quantities of the product which can be sold but also consideration of the prices at which various quantities can be sold. Thus, it is not possible to consider the delivery of a quantity of water in an area without reference to the price at which that quantity will be bought."—Report on the Engineering, Economic and Financial Aspects of the Feather River Project, Appendix A, 1955, pp. 4-5 (Ref. 67).

1/ In some recent studies, the Department of Water Resources has prepared estimates of market demand for water within certain service areas of the Feather River Project, based on broad ranges of probable prices.

4. The degree to which existing or other potential alternative sources of supply may or may not be adequate or competitive in meeting future water demands (taking into account the quality and quantity of these supplies, probable price levels, and seasonal and annual fluctuations in supply and demand).

5. The probable schedule of demand, through time, for project water, based on the foregoing considerations.

For the most part, water to be furnished by State projects under the California Water Plan will be in the nature of a supplemental supply. Thus, the demand for project water can be expected to fluctuate within a rather wide range both seasonally and annually, and competition from cheaper sources of supply will likely have an important influence on demand. Also, water users may be willing to pay a somewhat higher price for supplemental supplies, and this factor may affect demand estimates significantly.

Once the probable schedule of demand for project water has been prepared (and similar studies have considered the marketability of project power), the major basis exists for subsequent planning. It may immediately be obvious that demand is insufficient to warrant further consideration of a project; alternatively, the nature and extent of demand might suggest consideration of various other approaches, such as the institution of controls over water use, the improvement of existing supply systems through technical modifications, or the enlargement of the capacity of existing systems. If, on the other hand, a new surface water supply project of the conventional type seems warranted, the general size, design, and capacity of its works will be indicated by the demand forecasts.

Requirements for Other Project Services

The scope of public water resource development has broadened over the years, progressing from projects designed to serve such single functions as supplying water for irrigation use to complex programs for the control, conservation, and utilization of all water resources within a region or river basin. Thus, the "purposes" served by a typical modern project may include the control of flood waters; the storing and transporting of water for agricultural, municipal, and industrial use; the generation of hydroelectric power; the abatement of water pollution; the development of recreation areas; the improvement of navigation; and the protection of fish and wildlife resources. Advantages cited for multipurpose development include:

1. Economy (It may be cheaper to provide one project to serve several purposes than to provide separate projects to serve the same purposes.)

2. Maximization of development opportunities ("Favorable dam sites are rare, and it is essential that the potentialities of each site be utilized as fully as is practicable.")1/

3. Flexibility of operation (A project serving several purposes may, because of the complementary nature of those purposes, be more effective in serving the individual purposes than separate projects would be in serving the same purposes.)

The multipurpose concept of water resource development that has evolved in federal practice is the basis of the California Water Plan. Thus, the Plan contemplates that most projects will serve a number of purposes in addition to furnishing water and power. Here, again, studies undertaken in the early phases of project planning must establish the true nature and extent of the services required.2/ A proper assessment of these needs will include a balanced appraisal of their economic importance and impact, technical improvement opportunities, public health and safety requirements, and social values. By translating these various considerations into a quantitative requirement, the appraisals serve as a further basis for engineering planning.

Minimum Tests of Economic and Financial Feasibility

Even though some economic demand may exist for project commodities and services and it may be feasible from an engineering standpoint to construct the physical works, the cost of a program may not be warranted in view of the net expected economic gain. Establishment of economic demand does not in itself justify construction of a project. Just as private enterprise must weigh anticipated economic gains against the costs of producing those gains, so should public enterprise similarly evaluate its undertakings:

> It is a principle of good business, worthy of following in public business of this kind, that one does not knowingly embark upon projects from which the returns will not exceed the costs. The taxpayers individually would of course bar investment of their own savings in projects which are not economically sound. Inasmuch as the costs of [public] water developments are financed largely or solely by taxation, there is no justification. . . to spend the tax proceeds on uneconomical projects.3/

1/ Statement of Brig. Gen. W.E. Potter, U.S. Corps of Engineers, 1956, p. 16 (Ref. 208).

2/ There has been a tendency in federal programs to incorporate extra "purposes" in a project primarily as a means of reducing costs allocable to the primary purposes of the project.

3/ Engineers Joint Council, National Water Policy, 1950, p. 16 (Ref. 17). See also Task Force Report on Water Resources Projects (Appendix K), 1949, p. 30 (Ref. 211).

It is axiomatic that no capital investment, public or private, should be pursued if the expected economic (or social) gains do not exceed the estimated economic costs. To do otherwise is to waste resources. But the terms "economic gain" and "economic cost" require additional definition. To private enterprise, economic gain is dollar income, and economic cost is dollar expenditure. To public enterprise, these terms must have broader meaning if it is conceded that the objectives and viewpoint of government necessarily differ from those of private enterprise. 1/ Both private and public enterprise can be thought of as having "profit" motives, but whereas private profit is measured in terms of net dollar profit, the unique objectives of public enterprise usually require that public profit be measured in terms of a broader economic and social benefit. 2/

A private venture is deemed financially and economically feasible if sufficient capital is available for the investment and if the revenue anticipated will return a satisfactory profit. Comparable yardsticks are necessary to ensure the soundness of public investments. But there is usually no financial objective in a public undertaking other than (perhaps) that revenues be sufficient to recover financial costs. It is therefore inappropriate to judge the soundness of a public project in terms of its direct financial costs and revenues alone. This is particularly true in those instances in which the undertaking will not (and is not intended to) produce direct revenue at all, or will not produce sufficient revenue to cover its costs (or will depend on assessments or other involuntary payments for its revenues).

For these reasons, public enterprise differentiates between "economic feasibility" and "financial feasibility," whereas private enterprise does not usually make such a distinction. In public water resources projects, determination of economic feasibility must be considered a complete test separate and apart from determination of financial feasibility.

Test of Economic Feasibility

The economic feasibility of a public water project is customarily determined by means of a "benefit-cost analysis." A project is deemed economically feasible if the expected economic benefits exceed the expected economic costs. The multipurpose nature of most projects also requires that each separate purpose of a project (i.e., flood control, navigation improvement, irrigation water supply, municipal

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1/ If these differences were denied, both public and private undertakings would be subject to identical feasibility criteria. There would then be little or no reason for a government undertaking, since an investment attractive to government would be equally as attractive to private enterprise.

2/ For a further discussion, see The Report of the President's Water Resources Policy Commission, Vol. I, 1950, p. 59 (Ref. 239).

water supply, etc.) similarly develop benefits greater than the costs incident to the inclusion of that purpose in the project.

As will be indicated in more detail in Section V, the problems of defining, identifying, and measuring benefits are considerable and have been the subject of extensive debate. On the other hand, the objectives of a public enterprise require that the enterprise be evaluated in terms of its benefits and costs, irrespective of the specific manner in which "benefits" are defined and measured. Unless some practical means of quantitative evaluation exists, there is no way (other than by intuitive administrative judgment) of distinguishing between a proper and an improper public investment. No device has yet been suggested for this purpose that is clearly preferable to the benefit concept, assuming realistic definition and application,1/ and benefit-cost analysis therefore serves the same general purpose in evaluating a public undertaking as revenue-cost analysis serves in evaluating a private undertaking.

In general, benefits are a measure of the positive economic effects of a project; economic costs, against which benefits are compared, are a measure of the corresponding negative effects. If benefit-cost analysis is to be meaningful, the costs to be compared with benefits must be measured on the same broad basis as are benefits. Thus, public enterprise distinguishes between "economic costs" and "financial costs" in the same way (and for the same reason) that it distinguishes between economic benefits and financial benefits (revenues) and between economic feasibility and financial feasibility. In addition to financial expenditures incurred by the sponsoring agency in the construction, operation, and maintenance of a project, economic costs necessarily include certain other expenses and economic (or "social") losses that will result from the project.2/

To the degree that economic costs and benefits can be reduced to monetary terms, their relationship is customarily expressed in the form of a ratio of benefits to costs, and an economically feasible project or project purpose is one having a benefit-cost ratio in excess of unity.3/

1/ For further discussions see, for example, Views of the State of California on Elements of a National Water Resources Policy, 1950, p. 69 (Ref. 101); and Smith, S. C., "Research in the Economics of Water," 1957 (Ref. 450).

2/ The concept of economic costs will be discussed more fully in Section VI.

3/ When a benefit-cost ratio is exactly unity, benefits equal costs and there can be no "profit" on the investment. It will become apparent in the remainder of the report that a project will show a benefit-cost ratio substantially in excess of unity if it has been formulated properly.

The abuses and misinterpretations of benefit-cost analyses in water resource development have been widely discussed and reported. The most obvious reason for these abuses is that, as previously mentioned, the analyses have frequently not been undertaken until after a project has been fully formulated. If formulation has not taken place within an established economic and financial framework, then, certainly, it would only be coincidental that an after-the-fact evaluation would result in favorable findings. A review of the literature indicates that, rather than modify an engineering design in an effort to achieve necessary cost savings or abandon or defer a project, sponsoring agencies have sometimes been accused of manipulating the economic and financial data or otherwise distorting economic and financial concepts to "prove" a project feasible. If projects are formulated in this fashion, the danger of authorizing an economically unsound project will exist. Post-formulation analyses are usually too late to influence a decision since by that time irrevocable administrative and political commitments may have been made. A benefit-cost analysis is a valid technique only if benefits and costs are defined clearly and measured by means of established standards in as realistic and objective a manner as possible. The analysis is useful as a planning tool only if applied during, rather than after, the formulation process.1/

Test of Financial Feasibility

The term "financial feasibility" has been variously defined and interpreted. The usual private enterprise definition refers to an ability to finance an undertaking (i. e. , the availability of sufficient capital). Another definition frequently employed refers to the ability of a project to repay all financial costs from revenue (i. e. , a financially self-supporting project). As commonly used in public water resource development, however, the term refers to the ability of a project, or project purpose, to repay those financial costs assigned to it for repayment under established policies for cost sharing and cost recovery. 2/ A definite financial feasibility test therefore exists to be met, even though the test may not require that a project as a whole, or certain of its individual purposes, be financially self-supporting. By this definition, financial feasibility is synonymous with "repayment" feasibility.

1/ For an interesting and affirmative discussion of the value of benefit-cost analysis, see Ciriacy-Wantrup, S. V., "The Role of Benefit-Cost Analysis in Public Resource Development," 1954 (Ref. 274).

2/ These differences in definition have led to some confusion and misinterpretation. In its discussion of the Feather River Project, for example, the Bechtel report (Ref. 145) implies a finding of financial feasibility. The specific conclusion of the report, however, is that "it is feasible to finance" the project (i. e. , sufficient capital can be obtained).

From time to time it has been recommended that the test of economic feasibility be applied only to those project purposes whose financial costs are not to be repaid in full by beneficiaries, and that purposes whose costs are fully reimbursable[1] be subjected only to tests of financial feasibility. This reasoning is based on the assumption that benefit measurement is the equivalent of revenue measurement and is therefore necessary only when a project purpose produces no revenue at all or insufficient revenue to cover its financial cost. The argument would be valid if no distinction were made between economic costs and financial costs and between benefits and revenues. If the concepts previously discussed are accepted, however, benefits cannot be substituted meaningfully for revenues in comparisons with financial costs.

Thus, even though a project or project purpose may meet the test of financial feasibility, it may not (particularly in view of the definition of economic costs) meet the test of economic feasibility.[2] Conversely, by these definitions, an economically feasible project may not be financially feasible. It is therefore necessary to require that a project, and each of its separate purposes, meet both tests of feasibility to be acceptable.

Integrated Analysis of Projects

In formulating its projects, the Bureau of Reclamation has adopted a "basin account" concept of financial evaluation, under which revenues and costs attributable to two or more operationally related projects are pooled for purposes of analysis, so that the resulting complex of projects is re-evaluated as a single, integrated project. The Bureau's report on the proposed San Luis Unit, for example, combines the expected revenues and costs of that unit with those of existing units of the Central Valley Project.[3] Repayment analyses presented are therefore of the enlarged Central Valley Project rather than of the San Luis Unit itself, with excess revenues from one project available to offset costs of another. Addition of the San Luis Unit is regarded as

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1/ "Reimbursable costs" are those financial costs incurred by the government (i. e., the general taxpayer) for which repayment will be sought from project beneficiaries (i. e., water users, power users, etc.). "Nonreimbursable costs" are those costs that are allocated to particular project purposes but which will be borne, or absorbed, by the general taxpayer.

2/ For example, the inundation of valuable agricultural lands or the destruction of fish and wildlife resources may, together with other costs of the project, outweigh the benefit to be derived from a project--even though the project's financial costs could have been repaid by its beneficiaries.

3/ A Report on the Feasibility of Water Supply Development, 1955, pp. 17-19 (Ref. 205).

financially feasible by the Bureau because the broadened Central Valley Project as a whole meets the feasibility test. Since it is Bureau policy to require repayment in full within 50 years after completion of the last major unit, the effect of this financial integration is to extend the repayment period for the entire Central Valley Project. Presumably, the repayment period could be extended indefinitely by adding additional units. 1/

Arguments favoring the basin account concept point out that the projects are operationally interdependent, and that it is logical to consider their financial characteristics as interdependent. One obvious defect in this reasoning is that it permits addition of units that, if evaluated solely on their own merits, could not meet the feasibility requirements. When an uneconomic unit is added to an existing unit, the economic desirability of the complex is reduced--even though an evaluation of the new, enlarged project still may meet minimum standards of feasibility. As the system of projects expands and as early costs are amortized, new units added to the original project face progressively less stringent feasibility tests.

The State of California has commented as follows on the basin account concept as proposed in the Bureau of Reclamation report on the Colorado River Basin development:

> There is no justification in existing reclamation law for the consideration of economic feasibility of proposed projects on a basin-wide basis. . . Existing reclamation law requires that each proposed project be considered indivudally on its own merits and that a showing be made of engineering feasibility and of economic feasibility. . . All the projects previously authorized and constructed by the United States on the Colorado River System, including large developments such as the Boulder Canyon project, have been considered individually as to engineering feasibility and economic justification. . . There appears to be no reason at this time for creating new projects on a different basis. 2/

The Engineers Joint Council has commented similarly:

> Individual. . . projects, whether of single or multiple purpose, should each be subject to the standard criteria of economic justification. . . Authorization . . should be of

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1/ In its recent audit report on the Central Valley Project, the Office of the Comptroller General of the United States pointed out its inability to conduct a proper audit of project financial statements because, among other things, the pooling arrangement results in a constantly changing cost allocation. See Audit Report to the Congress of the United States, 1957, pp. 21 and 69 (Ref. 213).

2/ Task Force Report on Water Resources Projects (Appendix K), 1949, p. 26 (Ref. 211).

> individual projects fitting into comprehensive plans for streams or basins, but authorizations (as distinguished from approvals of comprehensive plans) should not be in blanket form. . . This recommendation is made with full recognition of the arguments advanced in behalf of "Basin Accounts" and the like. The result of the latter would, in effect, be to use surplus values or benefits accruing from the stronger projects in order to make up for the deficencies of the weaker projects. 1/

Only by requiring evaluations on a project-by-project basis can the State of California ensure that its over-all program of water resource development will be pursued along sound economic and financial lines. This does not mean that water resource development planning should not be on a state-wide or basin-wide basis, nor does it mean that surplus revenues ultimately expected from such developments could not be assigned to a special fund to assist in financing capital investments in future projects. It does mean, however, that approval of the California Water Plan should, if given, constitute an acceptance of the program as a broad outline, or master plan of development, rather than an authorization for construction of the specific projects or parts of the Plan. It also means that revenues or benefits of one project, or project purpose, should not be applied in project evaluations to offset costs of another project, or project purpose. As each individual project is proposed for construction, it should be evaluated and justified on its own merits prior to authorization.

Time and Risk Considerations in Project Analyses

From the standpoint of project analysis and evaluation, few factors are more difficult to take into account than time. This is true for at least two reasons:

1. Most of the factors which must be analyzed have not yet occurred; they will occur at some future time and are therefore subject to all the inexactness of prediction.

2. The factors to be compared may be separated from each other in point of time.

1/ Engineers Joint Council, National Water Policy, 1950 (Ref. 17). See also Circular No. A-47, 1952 (Ref. 179); Federal Inter-Agency River Basin Committee, Proposed Practices for Economic Analysis of River Basin Projects, 1950, hereafter referred to as the "Green Book" (Ref. 234); and Views of the State of California on Elements of a National Water Resources Policy, 1950, pp. 87 and 94 (Ref. 101).

Benefits, costs, and revenues must be predicted well into the future, and a considerable portion of the total expenditures must be made before any benefits or revenues accrue. Thus, a project which appears highly desirable at the time the dams and aqueducts are constructed may turn out to be highly undesirable if the predictions have been faulty. 1/

At best, the future is uncertain, and this uncertainty ought to be reflected in analyses through certain allowances for risk. Other things being equal, there should be a tendency to select the more conservative of several alternatives. If, for example, certain increments of a project can in fact be postponed, they probably ought to be postponed; otherwise the anticipated demand for the additional capacity may never develop, or it may develop more slowly than anticipated. 2/

The problem of project formulation is also rendered difficult because anticipated benefits (or revenues) and anticipated costs do not take place at the same point in time. Society would not be well advised to incur a cost of a dollar in order to obtain, <u>at some future time</u>, a benefit of no more than a dollar--particularly <u>if a dollar expended</u> in an alternative way would produce a future benefit of more than a dollar. Furthermore, an expenditure which will yield a benefit of a dollar in, say, 1970 is to be preferred to an equivalent expenditure which will yield a similar benefit in some later year. This is the essence of the concept of interest; and interest rates are the means by which present and future money values may be related and compared. Only when all future costs, benefits, and revenues are converted to a common time basis through the application of suitable interest rates can any proper judgment be made as to the economic and financial merits of a project proposal.

Thus, wherever various comparisons of anticipated benefits, revenues, and costs are discussed in this report, it should be understood that the values to be compared are first adjusted to some common time period, preferably the present. The cumulation of anticipated benefits, revenues, and costs and their expression on a common time basis can be accomplished either by discounting all values to their present worth or, more commonly, by converting them to average

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1/ It is the factor of uncertainty, or risk, which leads private enterprise to attempt to recover the cost of plants and equipment in as short a time as possible. Thus, if private enterprise were to implement the California aqueduct system, it would undoubtedly seek to recover its fixed cost outlays in a relatively short period of time--say, 20 years.

2/ For an excellent illustration of this point, see Milliman, J. W., "The History, Organization, and Economic Problems of the Metropolitan Water District of Southern California," 1956 (Ref. 498).

annual equivalent values.[1] Under either procedure, the interest (or discount) rate used provides a means both of recognizing the time value of money and of allowing for the risk of prediction.

There is some disagreement with respect to the rate of interest to be employed for this purpose. Some points of view are as follows:

1. The interest rate should be equal to that paid by the government in borrowing investment capital for the particular project.

2. The interest rate should be equal to the average cost of money on long-term government borrowings.

3. The interest rate should be somewhat higher than the cost to the government for borrowed money to reflect a difference in risk.

4. The interest rate should be commensurate with the return that might have been obtained had the individual taxpayers invested in a private venture of similar risk.

The selection of an appropriate interest or discount rate is a matter of considerable consequence since the economic and financial feasibility of a project become less likely as the interest rate is increased. While the minimum rate of interest to be used for this purpose would seem to be one that coincides with the average rate of interest applicable to long-term government borrowings, most studies of federal procedures in this regard have urged that a somewhat higher rate than this minimum be used in order more nearly to reflect the opportunity cost of the resources used—in order to reflect, that is to say, the return on investment which could have been obtained if the resources committed to water development had been used in some alternative manner.[2]

The effect of various discount rates on the present worth of future values is demonstrated in Figure 1, which shows a hypothetical series of annual benefits of $100,000 each discounted at rates varying from 3 to 6 percent. Incremental increases in present worth decline in all cases as the period of analysis is extended, but this effect is much

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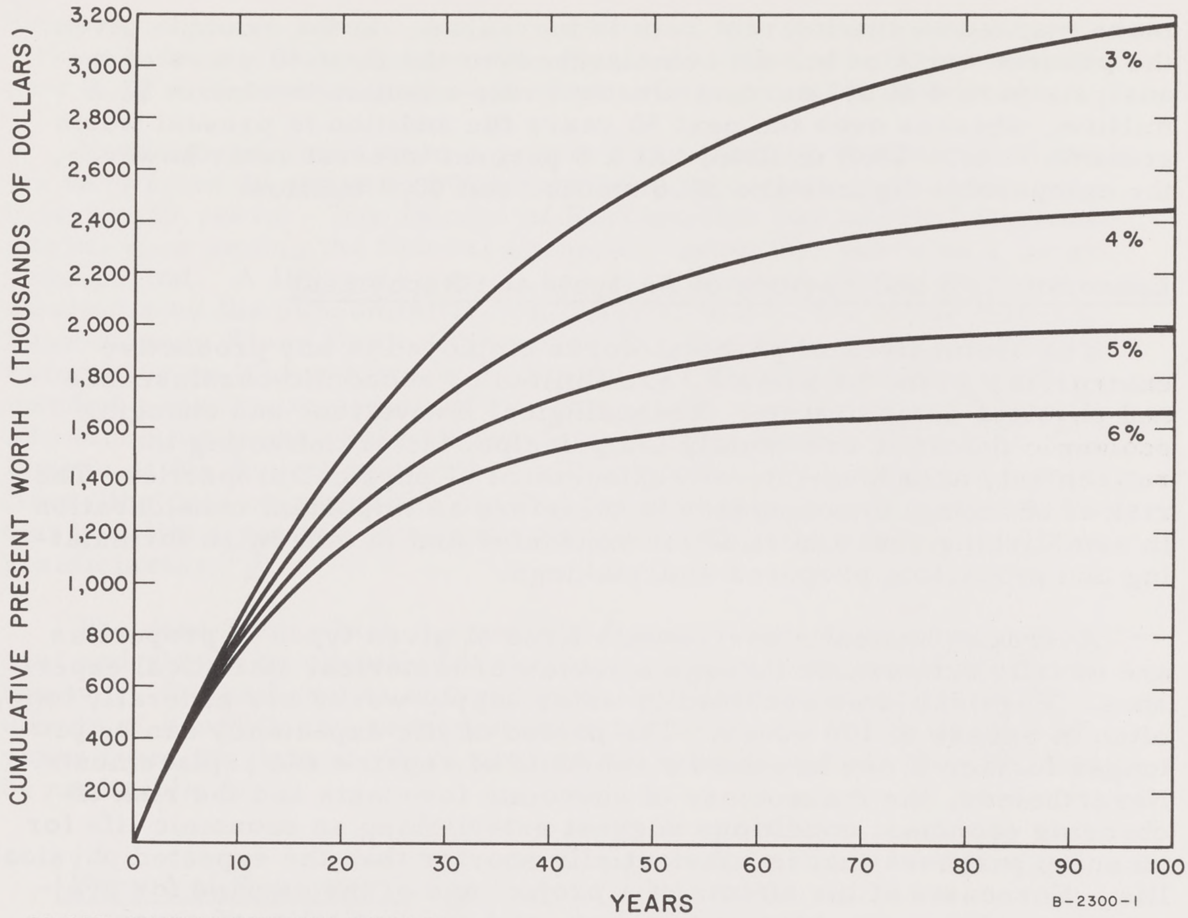
1/ For a discussion of the specific techniques used in discounting anticipated values to present worth or in converting those values to average annual equivalents, see, for example: Grant, E. L., Principles of Engineering Economy, 1950, p. 40 (Ref. 21).

2/ In general, current federal policies prescribe the use of an interest rate of $2\frac{1}{2}$ percent. For State projects, the Department of Water Resources has tentatively adopted a $3\frac{1}{2}$ percent rate. Both interest rates are intended to reflect no more than the long-term borrowing rates of the respective governments.



SOURCE: STANFORD RESEARCH INSTITUTE.

FIGURE 1

PRESENT WORTH OF ANNUAL BENEFITS OF $100,000
(CUMULATED FOR 0-100 YEARS AT DISCOUNT
RATES OF 3, 4, 5, AND 6%)

more marked as the interest rate is increased. In the example given, the present worth of benefit cumulation over the first 50 years of the analysis period at a 3 percent discount rate amounts to almost $2.6 million, whereas over the next 50 years the addition to present worth amounts to only $0.6 million. At a 6 percent interest rate, however, the comparable figures are $1.6 million and $0.1 million.

Economic Life and Periods of Analysis and Repayment

The useful lives of physical works employed in any productive enterprise, public or private, are limited by economic obsolescence and physical deterioration. Technological innovations and changing economic demands are usually the principal factors effecting the retirement, abandonment, or replacement of physical properties. The risk of economic obsolescence is therefore an important consideration in establishing cost amortization schedules and in otherwise formulating and evaluating proposed undertakings.

Average physical and economic lives of given types of properties are usually determined through a review of historical statistical experience. Physical lives ascribed to water supply works are generally long, often in excess of 100 years. The period of life expectancy can be prolonged further if one assumes a schedule of repairs and replacements. Nevertheless, the inexactness of economic forecasts and the risk of changing economic conditions suggest establishing an economic life for planning purposes that is substantially shorter than the expected physical life. Forecasts of the effects of a project and of the demand for project commodities are subject to error, and susceptibility of error increases the farther those projections extend into the future. There is risk, too, that new technological developments (e.g., sewage reclamation, nuclear power utilization, water use improvement, weather control, and saline water conversion) might result in a substantial alteration of the schedule of demand for project products.

Establishment of an official economic life for a project sets an upper limit on the period of time over which (1) the probable quantitative effects of the project are to be taken into account in the formulation and evaluation process, and (2) the financial costs declared reimbursable are to be repaid by project beneficiaries. The selection of the period of economic life must largely be arbitrary, based on administrative judgment. In federal practice it has become customary to establish specific time limits governing the periods of analysis and repayment to further minimize economic risk.

Period of Analysis

An administrative or legislative decision with respect to the permissible period of analysis has an important bearing on project feasibility determinations and on the scope and scale of particular

developments. A longer period of analysis will result generally in less stringent feasibility requirements than will a shorter period and will tend to permit construction of projects of larger scope and scale.

Recommendations as to a proper time limit on the period of analysis vary from 40 years to 100 years and, in certain circumstances, even to 150 years. The Bureau of Reclamation has adopted the most liberal view among the federal agencies, using 100 years as a maximum period. A 100-year period has also been recommended as a maximum by the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee.1/ The Presidential Advisory Committee on Water Resources Policy, on the other hand, recommended a maximum period of 50 years, with an additional 10-year allowance for those projects requiring a development period.2/ The Bureau of the Budget prescribes a limitation of 50 years, measured from "the date on which the head of the sponsoring agency determines that benefits from the program or project will be available to beneficiaries."3/

The date from which the period of analysis is measured is significant and should be specified if the limitation is to be meaningful. If, however, future benefits and revenues are discounted properly, the effects of benefits and revenues expected to accrue much beyond 50 years from the date at which project operations commence will likely be negligible.4/

Period of Repayment

The repayment period is that length of time over which the reimbursable financial costs of a project are to be repaid by beneficiaries. In federal practice it is customary to require repayment within the economic life of a project, or within a specified number of years, whichever period is less.

There is no necessary relationship between the period of analysis and the period of repayment. The period of repayment expresses the degree to which the general taxpayer is willing to extend credit to the

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1/ "Green Book," 1950, p. 26 (Ref. 234).
2/ U.S. Presidential Advisory Committee, Water Resources Policy, 1956 (Ref. 237).
3/ Circular No. A-47, 1952 (Ref. 179).
4/ Financial analyses thus far published for the Feather River Project extend over a period of 70 years, and future values have not been discounted to their present worth or to average annual equivalents. See Program for Financing and Constructing the Feather River Project, 1955 (Ref. 110).

project beneficiary. Thus, it has been possible for the Bureau of Reclamation, for example, to adopt a 100-year period for purposes of benefit-cost analysis and, generally, a 50-year period for purposes of repayment. 1/

The State of California, in commenting in 1950 on the Bureau's repayment concepts, expressed the following view:

> Federal policy has not been consistent in prescribing the period of repayment of costs to the Federal Government for the irrigation component of a project. During the last 45 years, the repayment period has been extended from 10 years to 40 years. In recent reports the Bureau of Reclamation has recommended its extension substantially beyond 40 years. The Federal Land Bank, the Farmers Home Administration, and other farm loan institutions grant farm loans not to exceed 40 years' duration. Likewise, California irrigation districts which have bonds outstanding, have repayment periods of less than 50 years' duration, with most extending from 20 to 30 years. The uncertainty and unpredictability regarding the long-time outlook for agriculture should preclude consideration of a repayment period in excess of 40 years. 2/

In its function of reviewing federal project proposals, the Bureau of the Budget has adopted the following policy:

> Rates and other charges for the products or services of a program or project shall be set so that repayment of the initial Federal investment. . . can be accomplished within a period equal to the useful economic life of the proposed program or project, but not longer than 50 years, following the date on which the head of the sponsoring agency determines that benefits from the program or project will be available to the beneficiaries. This same period of time with the same limitation shall be used for computing benefits and costs of the proposed program or project. 3/

1/ The Bureau has extended the repayment period for certain projects. Usually, however, it requires full repayment from contracting agencies within 50 years, including a 10-year development period. The repayment period for a project as a whole, however, is measured from the time that the last major feature of a project comes into service.

2/ Views of the State of California on Elements of a National Water Resources Policy, 1950, p. 82 (Ref. 101). See also Views of the State of California on Water Resources and Power Functions of Federal Departments and Agencies, Appendix B, 1954 (Ref. 128).

3/ Circular No. A-47, 1952 (Ref.179).

Even though it must be arrived at in a somewhat arbitrary fashion, the decision as to the repayment period for State projects will have an important bearing on the financial aspects of those projects, affecting prices to be charged for vendible commodities and, in turn, the extent of demand for those commodities.

Price Levels

Ideally, the values of future benefits, revenues, and costs should be estimated on the basis of average price levels expected to prevail at the time those effects are to accrue. The practical difficulties of arriving at reliable predictions, however, have led to considerable study and discussion. 1/ The usual federal practice is to employ current price levels in estimating the more immediate costs of construction but projected long-term price levels for computing the value of benefits and deferred costs. Opinion is divided as to whether or not the use of current price levels would be sufficiently accurate for all project evaluation purposes.

Although it is true that risk of error is inherent in any forecast of future price levels, the possibility of error may be greater if it is assumed, for some planning purposes at least, that price levels will not change. This is particularly true of those types of costs, such as construction costs, which have evidenced marked trends in the past. A decision with respect to price level, however, would seem to depend mainly on the use to which the estimates are to be put. When the purpose of an analysis is to compare the relative merits of competing proposals, for example, then the use of current prices would seem to offer a sufficient degree of accuracy. If, however, the purpose of an analysis is to judge the absolute merits of a given proposal, then it would seem necessary to forecast prices in as realistic a manner as practicable.

Project Selection from among Feasible Alternatives

It has thus far been suggested that a project is a worthwhile public investment if it will serve true economic and social needs and will meet certain standards of economic and financial feasibility. It is not sufficient, however, that minimum criteria be satisfied; there should be assurance that the particular plan proposed represents the best plan in view of the practical alternatives available—including the sometimes overlooked alternative of not building anything at all. Unless all of these alternatives are identified and evaluated on the basis of their relative engineering and economic merits, improper solutions are likely to result while proper solutions remain unrecognized.

1/ See, for example, "Green Book," 1950, pp. 17-19 and 25 (Ref. 234); and Task Force Report on Water Resources and Power, Vol. 1, 1955, p. 100 (Ref. 210).

Assuming that a sponsoring agency has determined that the construction of a conventional multipurpose project is justified in view of other alternatives,[1] there remain the problems of selecting the various components (from alternatives available) and determining the sizes and capacities of those components (from alternatives available). To the extent that these selections and rejections are made on the basis of relative economic desirability, an orderly and proper capital investment program will result.

Even though a particular project design may meet the established minimum tests of economic and financial feasibility, it may not represent an economic optimum in terms of size, capacity, design, and/or cost. Estimates of economic demand and requirements of economic and financial feasibility establish only general parameters of project scope, scale, and cost; they do not serve sufficiently to control total investment or to assure that the plan selected is in fact the best of several alternatives, each of which could meet or exceed minimum standards of engineering, economic, and financial feasibility.

In selecting a specific plan of development, a private investor is usually guided by one of two criteria. Depending on the particular circumstances of the investor, an optimum solution may be achieved by selecting a plan that will maximize either:

1. Net profit (i.e., the difference between the discounted values of future gross revenues and costs), or

2. Rate of return on the capital sum invested (i.e., the difference between the discounted values of future gross revenues and costs, divided by the capital cost).

If an entrepreneur always had the option of channeling additional investment into new enterprises which could duplicate the performance of the original enterprise, he would limit his investment in the original undertaking to that which would maximize rate of return; he would channel investment into the second and the third and the fourth, and so on—always with the objective of maximizing the rate of return on each investment. But if such alternative enterprises were not available, or if he were otherwise limited in his investment interests, he would channel additional investment into the original enterprise with a view toward increasing net profit, regardless of a decrease in rate of return.

A similar line of reasoning can be (and usually is) followed in public water resource development. The problem of selecting from among alternative projects or project components is akin to that of

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1/ As previously discussed, other alternatives might include the modification or enlargement of existing systems, the institution of controls over water usage, or the development of new processes, such as the reclamation of sewage or the conversion of sea water.

selecting an output capacity when investment interests are not as yet limited. The problem of optimizing the scope and scale of a particular project or project component is akin to that of selecting an output capacity for a specific enterprise when alternative investment opportunities are no longer available. But, again, it should be remembered that whereas private enterprise is interested in measuring its criteria for these purposes in terms of financial revenues and costs, public enterprise is interested in measuring comparable criteria in terms of economic benefits and economic costs. As previously discussed, the objective of a public project with respect to financial costs and revenues is merely that revenues be sufficient to cover those costs that are declared reimbursable.

Two principal criteria have been used in evaluating public water resource projects for purposes of selecting projects or project components from among alternatives and for selecting an optimum scope and scale for a particular development. Depending on the purpose for which the evaluation is made, the objective may be to maximize one of the following:

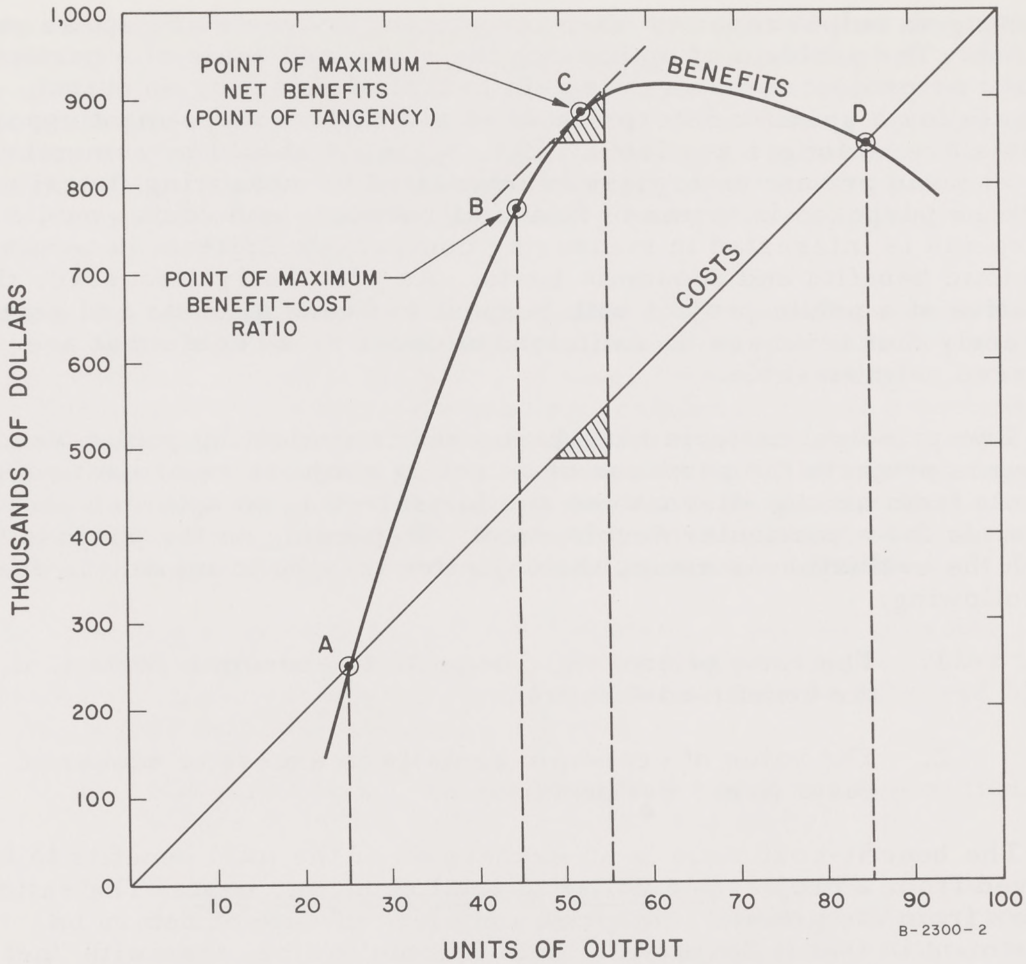
1. The ratio of economic benefits to economic costs (i. e., the benefit-cost ratio).

2. The value of economic benefits in excess of economic costs (i. e., net benefits).

The benefit-cost ratio is an expression of the total benefits to be derived from a project <u>per</u> <u>dollar</u> <u>of</u> <u>total</u> <u>economic</u> <u>cost</u>. The ratio differs from the private enterprise criterion of rate of return on investment in that it deals with "total income" rather than with "net income" and total costs rather than with capital costs. Maximization of net benefits corresponds with the private enterprise criterion of maximizing net profits.

Figure 2, which is a plot of benefits and costs as they might relate to hypothetical water supply facilities of various output capacities, illustrates that the maximum benefit-cost ratio and the maximum net benefits may occur at somewhat different outputs.

In the example given, any project with an output capacity between that at point A and point D would meet the minimum standard of economic feasibility (i. e., a benefit-cost ratio in excess of unity). Initially, as the output capacity increases beyond that at point A, both the benefit-cost ratio and the value of net benefits increase. The maximum benefit-cost ratio occurs at point B, since at that point the rate of increase in benefits per unit of cost is at a maximum. From point B to point C, net benefits continue to increase, but the benefit-cost ratio declines. At point C (the point at which a line drawn parallel to the cost line is tangent to the benefits curve), the cost of adding the last increment of capacity is exactly equal to the benefits to be derived from that increment. In other words, at point C the rate of increase



POINT	BENEFIT-COST RATIO	NET BENEFITS IN THOUSANDS OF DOLLARS (BENEFITS LESS COSTS)
A	1.00	--
B	1.72	325
C	1.67	350
D	1.00	--

SOURCE: STANFORD RESEARCH INSTITUTE, BASED ON "GREEN BOOK," 1950, p. 12 (REF. 234).

FIGURE 2

RELATIONSHIPS BETWEEN BENEFITS AND COSTS FOR VARYING OUTPUT CAPACITIES

in benefits becomes equal to the rate of increase in costs. The maximum value of net benefits therefore occurs at point C.

Although there is some disagreement[1/] as to the point of optimum scope and scale, it is generally felt that the objective in a given developmental opportunity (e.g., a selected project or project component) should be to maximize net benefits (point C). The reasoning is that once public funds are made available for a particular water resource project, they are usually restricted to that purpose; that is, there no longer are alternative opportunities for investment. Thus, as would be the case in a comparable private investment situation, the objective should be to maximize "net profit." As has been indicated, this point occurs when the benefits added by the last increment of capacity equal the costs necessary to add that increment.

The problem of selecting the best of two or more alternative developmental opportunities (e.g., a choice between two or more projects or project components) is a somewhat different matter than optimizing the scope and scale of a single development. There is agreement that project alternatives ought to be ranked in the order of their relative economic desirability, other things being equal. There is, however, some disagreement as to the specific criterion to be employed in determining relative economic desirability.[2/]

In the discussion just concluded, it was suggested that the optimum point of development for a given project or project component is achieved when net benefits are maximized. The maximization of net benefits in such an instance permits a greater realization of the potential of a given opportunity within a rather narrow range of cost. While this technique may be valid when applied to a specific development whose general parameters have already been established, it may not be by itself adequate to evaluate the relative economic merits of two or more competing projects or project components. In the following example,

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1/ See, for example, McKean, R.N., "Criteria for the Selection of Water-Resource Projects," 1956 (Ref. 336); "Green Book," 1950 (Ref. 234); Circular No. A-47, 1952 (Ref. 179); U.S. Presidential Advisory Committee, Water Resources Policy, 1956 (Ref. 237); Views of the California State Department of Water Resources on U.S. Senate Resolution 281, 1956, p. 11 (Ref. 120); and Timmons, J.F., "Economic Framework for Watershed Development," 1954 (Ref. 383).

2/ See, for example, Renshaw, E., "The Controversy over Alternative Procedures for Ranking Water Resources Projects," 1956 (Ref. 516).

Project A has a total cost of $6 million and net benefits of $2 million. Project B has a cost ten times as great, or $60 million, yet produces the same value of net benefits:

	Project A	Project B
Investment costs	$5,000,000	$50,000,000
Operating costs	1,000,000	10,000,000
Total costs	$6,000,000	$60,000,000
Total benefits	8,000,000	62,000,000
Net benefits	$2,000,000	$ 2,000,000

Thus, the criterion of maximizing net benefits does not sufficiently take into account relative differences in cost.

A preferable method for ranking projects <u>for initial selection</u> is one that evaluates benefits in relation to costs. Traditionally, in federal practice, project selection and priority assignment have been on the basis of the most favorable benefit-cost ratio. In recent years, it has sometimes been recommended that selection be on the basis of the most favorable "net benefit-investment ratio" (i.e., the ratio of net benefits to capital costs). Arguments favoring this criterion stress its comparability to the rate-of-return criterion of private enterprise, and point to an inadequacy of the benefit-cost ratio that results from its emphasis on total economic costs rather than on capital, or investment, costs.

In practice, a project or project component with the greatest benefit-cost ratio probably will also be the one with the greatest net benefit-investment ratio. It is true, however, that where there is wide disparity among projects in terms of the proportion of operating costs to total costs, use of benefit-cost ratio comparisons may be misleading.

In the following example, both projects have equal investment costs, but operating costs of Project A are substantially lower than those of Project B. If selection were on the basis of the most favorable benefit-cost ratio, Project A would appear preferable, even

though the net benefits to be realized from Project B are greater. Selection on the basis of the net benefit-investment ratio would properly favor Project B:1/

	Project A	Project B
Investment costs	$5,000,000	$5,000,000
Operating costs	100,000	3,000,000
Total costs	$5,100,000	$8,000,000
Total benefits	6,000,000	9,000,000
Net benefits	$ 900,000	$1,000,000
Benefit-cost ratio	1.18	1.13
Net benefit-investment ratio	0.18	0.20

In the following example, all three projects show the same benefit-cost ratio and the same value of net benefits. By applying the net benefit-investment ratio, however, Project A is shown to be preferable:

	Project A	Project B	Project C
Investment costs	$11,000,000	$13,000,000	$15,000,000
Operating costs	8,000,000	6,000,000	4,000,000
Total costs	$19,000,000	$19,000,000	$19,000,000
Total benefits	20,000,000	20,000,000	20,000,000
Net benefits	$ 1,000,000	$ 1,000,000	$ 1,000,000
Benefit-cost ratio	1.05	1.05	1.05
Net benefit-investment ratio	0.09	0.08	0.07

1/ For purposes of simplification, this example and the one that follows assume that there are no economic costs over and above financial costs.

In most instances, the benefit-cost ratio would seem to be a satisfactory indicator of the relative economic desirability of projects or project components, but it should not be relied upon exclusively. The net benefit-investment ratio should also be considered in the selection of projects and in the assignment of construction priorities.

Review of the Formulation Process

The economic definition of a project was considered at the outset of this section of the report. The remainder of the section has suggested that a project will be formulated in accordance with that definition if:

1. Its size and capacity are closely related to the expected near-future, rather than eventual, economic demands for its commodities and services.

2. The present worth of its anticipated benefits exceeds the present worth of its anticipated economic costs, measured within the period of analysis specified.

3. The present worth of its anticipated revenues equals the present worth of its anticipated reimbursable financial costs, measured within the period of repayment specified.

4. The present worth of its anticipated benefits per dollar of economic cost1/ (i. e., its benefit-cost ratio) is greater than that of any other practical alternative.

5. The present worth of the excess of its anticipated benefits over its anticipated economic costs (i. e., the value of net benefits) is greater than would be the case if its scope and scale were either larger or smaller.

1/ Or, when applicable, per dollar of capital cost.

Section V

BENEFITS

The previous sections of the report have emphasized that proposed public investments require evaluation in terms of the broad economic and social benefits which will accrue during the life of the project. The benefits of many types of public enterprises, such as auditoriums, parks, and libraries, are largely beyond quantitative measurement and can be evaluated only subjectively. But in the case of other types of public enterprise, such as highway developments, housing programs, sanitary plants, and soil conservation measures, and particularly in the case of water projects, quantitative evaluation of benefits is more feasible.

To the extent that anticipated benefits can be measured in money terms, they serve the same general purpose in the formulation and evaluation of a public water project as do anticipated revenues in the formulation and evaluation of a private undertaking. The identification and measurement of anticipated benefits is difficult, however, and results obtained are often imprecise. In spite of the efforts of many study groups, both inside and outside of government, the measurement of anticipated benefits remains the weakest link in the formulation and evaluation process. Nevertheless, if decision-making is not to be based solely on subjective judgments, benefit-cost analysis is necessary. And, unless consideration of benefits is subjected to standard definitions and measurement procedures, comparative evaluations of various project proposals are meaningless, and sound economic analysis is largely impossible. This section of the report therefore discusses the concept of economic benefits and the manner in which they might be measured.

General Concept

The benefits of a given project may be thought of as all the identifiable gains or increases in real income--whether expressed in goods, services, money, or satisfactions--which result from the construction and operation of the project. 1/ Conceptually, benefits include all favorable effects, regardless of to whom they accrue and whether or not they can be evaluated in money terms.

1/ Real income is income expressed in terms of the real goods and services which satisfy the desires of human beings rather than in terms of money which is merely a standard of value or a medium of exchange. Of course, real income can be expressed in money terms.

Classification

The project formulation process requires that the benefits of each separate purpose of a multipurpose project be considered independently. Thus, benefits may be classified by project purpose: irrigation water supply, flood control, hydroelectric power generation, etc. The measurement of benefits in each of these various classifications will be considered later in this section. In addition, benefits may be classified as being: primary or direct; secondary or indirect; market or tangible; and extra-market or intangible.

Primary benefits are those gains or increases in real income which accrue to the people who use the products or services made available by the project. Secondary benefits are those gains or increases in real income which accrue to persons other than the primary beneficiaries as the result of activities indirectly stemming from or induced by the project. 1/

Market, or tangible, benefits are those which are capable (in fact or in practice) of being measured in money terms; extra-market, or intangible, benefits are those which cannot be measured in money terms. It is therefore possible to identify primary or secondary benefits in both market and extra-market categories. 2/ Improved public health and safety conditions, the creation of scenic values, increased local economic stability, the control or conservation of certain resources, or a contribution to national security in terms of added self-sufficiency are often cited as examples of the extra-market or intangible benefits of water resource developments. By definition, extra-market benefits cannot be taken into account in the quantitative analysis of a project, but they may nevertheless be of sufficient significance to be regarded qualitatively in weighing the relative merits of otherwise equally desirable proposals or as an additional consideration in assessing the absolute merits of a given proposal.

The Identification and Measurement of Primary and Secondary Benefits

The principal problems relating to the identification and measurement of anticipated project benefits derive from the fact that they accrue over a period of time extending well into the uncertain future. Major difficulties arise as a result of the necessity of predicting such matters as general economic conditions, price levels, price supports, subsidies, tariffs, and surpluses. To derive quantitative estimates of benefits it is necessary to anticipate future demands or needs for the

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1/ Secondary benefits include values generated by increased economic activity resulting from the project, such as those derived from additional agricultural output, or from new commercial or industrial activity.

2/ In general, however, market benefits tend to be primary benefits, and extra-market benefits tend to be secondary benefits.

products and services of the project, and it should be recognized that there will invariably be a large margin of error inherent in any calculation based on projections over, say, a 50-year period. Indeed, it has been urged at the federal level that benefit estimates be expressed in ranges rather than in single figures to reflect these uncertainties.1/ As has been indicated in Section IV, a strong case can be made for employing a relatively high interest rate when anticipated benefits are discounted to the present for purposes of benefit-cost comparisons.

The federal government has employed various methods for the measurement of benefits by project purpose. A review of these methods indicates that they are compatible with certain general principles and that the calculation of primary benefits is reasonably straightforward by comparison with the calculation of secondary benefits. Before discussing these methods, however, it is desirable to consider the measurement of primary and secondary benefits from a conceptual standpoint.

Primary Benefits

Primary benefits, as previously defined, are the gains or increases in real income which accrue to the people who use the products or services made available by the project. Conceptually, if each primary beneficiary were aware of the true value to him of the project's primary benefits, the maximum amount of money he would be willing to pay for them would be the measure of their money value. Theoretically, therefore, it would be possible to measure the over-all primary benefits of a project by ascertaining these maximum amounts of money which the primary beneficiaries collectively would be willing to pay for the various amounts of the products or services.2/

In practice, primary beneficiaries may not be able to determine the true value to them of project benefits--particularly those benefits which will not materialize until many years hence--and it may be desirable for the State to compute benefits in some alternative manner. While this concept of a primary benefit is clear, it should also be

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1/ Circular No. A-47, 1952, p. 6 (Ref. 179).

2/ In technical language, a schedule indicating the relationship between the per-unit benefits of a project and the various levels of possible project output is a demand schedule. The problem of measuring benefits is, in part, one of knowing how best to estimate the demand relationships. If the project were constructed so that the marginal direct benefits equalled or exceeded the marginal financial costs, moreover, the project would automatically be fully reimbursable in the sense that all of the financial costs of the project could be paid for by the primary beneficiaries.

recognized that a project cannot be regarded as providing a benefit value in excess of what it would cost the beneficiary to obtain an equivalent benefit from an alternative source. For example, the benefit from project hydroelectric power cannot exceed in money value the cost to the power user of obtaining equivalent steam-generated power. Similarly, the benefit from project water cannot exceed in money value the cost to the water user of obtaining water of an equivalent quality from an alternative source. Furthermore, the benefit to society from each additional unit of project output tends to decline as project output is increased. To illustrate, the benefit from 4 million acre-feet of water is likely to be something less than twice that of 2 million acre-feet of water, and it would be incorrect in computing aggregate benefits to multiply the benefit from the first unit produced by the total number of units produced.

In considering the problem of measuring primary benefits, it may also be noted that the output of some project purposes (e.g., water for municipal use) is of benefit directly to consumers whereas the output of other project purposes (e.g., water for irrigation or industrial use) becomes a means of further production and is therefore of benefit only in the sense that it adds to the value of the goods which the beneficiaries produce. In the former case, estimating benefits really involves estimating the sum of the values to individual consumers, while the problem in the latter case is one of determining the value added to the beneficiary's product as the result of using project commodities. It is the practice of federal agencies to measure this added value by subtracting from the value of the beneficiary's product the costs (including a fair return to enterprise) of all the other-than-project factors which contribute to that value. As will be indicated in Section VI, the costs of all of these other factors are called "associated costs." Ideally, of course, it should be the benefits (rather than the costs) attributable to these other factors which are subtracted in order to isolate the net benefits attributable solely to the project, but this may be a practical impossibility. In any event, at least conceptually, the approach of the federal agencies appears to be sound, particularly if the results are checked against demand studies.

Secondary Benefits

While primary benefits are attributable to the people who use the commodities or services of a project, secondary or indirect benefits accrue to the people whose activities indirectly stem from or are induced by the project. Ideally, the measurement of secondary benefits should involve subtracting the money value of the primary benefits from the total money value of all of the beneficial effects which could be traced to the project. In practice, however, the identification and measurement of secondary benefits is extremely difficult and complex, if not impossible.

A part of the problem results from the fact that there is no practical way of determining the extent to which the secondary benefits apparently due to the project would have occurred in the event that the project had not been undertaken. 1/ Calculations would depend upon such considerations as the nature of hypothetical alternative investments, the relative effectiveness of real agents of production in producing a given real income, and the level of employment of various resources. As a general rule, benefits--both primary and secondary—arise only as a result of the shifting of resources from less to more productive areas and uses, and if secondary benefits exist at all they exist within this frame of reference. 2/

A particular difficulty arises because the point of view with respect to the magnitude of secondary benefits may vary depending on the particular geographic area under consideration. A project might well result in increased economic activity in one area in the sense of stimulating the movement of labor and industry into that area. But if the labor and industry which moved to that area came from another area of the State (or would otherwise have moved into another area of the State), the result is merely an inter-regional transfer of economic activity and the net secondary benefits to the State as a whole are likely nil.

The extent to which secondary benefits can and ought to be considered in project evaluations is a matter of considerable controversy. It is undoubtedly true that benefits of water development accrue in some degree or other to individuals other than the primary beneficiaries. The rapid economic growth of the State of California as a whole, and of Southern California in particular, appears to be a testimonial to the fact that some secondary benefits may be derived from water development programs. But, how much of that growth is quantitatively attributable to water development?

Because of the difficulties of identification and measurement, consideration of secondary benefits--at least for purposes of project formulation and evaluation--has generally become suspect. At the federal level, secondary benefits sometimes have been combined with primary benefits when, on the basis of primary benefits alone, the project would have been unable to meet the test of economic feasibility. Technical difficulties have on occasion resulted in a double counting of benefits, or, in the usual case, a failure to take into account the secondary benefits attributable to more than one project purpose. 3/ Moreover, wherever secondary benefits have been combined with primary benefits in benefit-cost analyses, their consideration has tended to complicate and obscure the basic benefit calculations.

1/ Regan, M. M. and J. F. Timmons, "Current Concepts and Practices in Benefit-Cost Analysis of Natural Resource Developments," 1954, p. 4 (Ref. 360).

2/ Haver, C. B., "Secondary Benefits," 1955, pp. 10-15 (Ref. 483).

3/ The Bureau of Reclamation, for example, seeks to evaluate only the secondary benefits of the irrigation purpose of a project.

The problems inherent in any broad appraisal of secondary benefits have been expressed by a panel of consultants to the Bureau of Reclamation as follows:

> Secondary benefits are much less certain and calculable than primary, and more dependent on far-reaching hypotheses. Moreover, it appears that usable formulas cannot be based on data that are capable of furnishing complete and accurate comparisons of effect with and without a given project. 1/

Perhaps the most reasonable conclusion to any discussion of secondary benefit measurement is that the extent to which these measurements ought to be undertaken depends largely on the use to which they subsequently will be put. For most project formulation purposes, the objective of benefit-cost analysis is to compare the relative merits of alternative proposals, and, in those instances, consideration of primary benefits would seem adequate. In deciding upon the absolute merits of a given proposal, consideration of secondary benefits would seem necessary only in marginal cases and, even then, a qualitative appraisal of those benefits would likely suffice. Certainly, if secondary benefits are to be taken into account at all in the project formulation and evaluation process, they should be viewed as additional considerations separate and apart from primary benefits.

Since secondary benefits can be evaluated from a local viewpoint more meaningfully and with greater confidence than they can from a state-wide viewpoint, they may have considerable usefulness in establishing or justifying repayment arrangements at the local level:

> Identification of secondary net benefits in industry or regional accounts stimulates a better understanding of regional as distinguished from national effects of public resource development. It has practical significance as a preliminary step toward broadening the repayment base--which is sometimes rather narrow if confined to primary benefits--toward obtaining dependable repayment contracts from groups of beneficiaries, and toward making special taxes more acceptable. 2/

The Measurement of Benefits by Project Purpose

Irrigation Water Supply Benefits

The identification and measurement of the benefits from irrigation water supply has been a controversial issue, with widely divergent

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1/ Bureau of Reclamation, Report of Panel of Consultants on Secondary or Indirect Benefits of Water-Use Projects, 1952, p. 12 (Ref. 204).

2/ Circiacy-Wantrup, S. V., "The Role of Benefit-Cost Analysis in Public Resource Development," 1954, p. 24 (Ref. 274).

procedures in use by the different federal agencies. However, there now appears to be general agreement that the direct benefits from irrigation water supply should be defined, in principle at least, as the value of the anticipated increased farm production less the associated costs (including an imputed return on the farmers' own capital, land, and labor). 1/ There are, however, practical difficulties in deriving such estimates.

The method currently used by the Bureau of Reclamation involves calculations based on summaries of farm budget data under conditions expected with and without the project. 2/ The method is sound so long as adequate allowance is made for increased farm costs (i. e., associated costs). Additional income to be derived from increased production expected from both the application of irrigation water and, say, the use of better seed cannot all be attributed to the water project. Difficulties inherent in the method are those attendant in estimating future cropping patterns, future demand and prices for various products, and the impact of technological advancements.

Another method sometimes suggested for measuring the direct benefits from irrigation water supply is to determine the probable increase in land value that will occur. While the increase in the market value of farm land would seem a sound measure of the economic benefits accruing from irrigation, its determination is probably too difficult for practical use. For example, a given tract of farm land may increase in market value as the result of speculation in anticipation of water availability, or improved access because of road construction, or increased local demand for farm land because of population growth patterns.

Flood Control Benefits

The primary benefits of flood control may be measured by considering (1) the value to be derived from the reduction or prevention of flood damage based on the estimated cost of replacing or rehabilitating damaged property, (2) the reduction or elimination of the costs of emergency measures such as flood fighting and flood relief, and (3) increased net incomes realizable from an intensified or higher land use made possible in the flood zone.

Basic data are usually derived by historical review of flood frequencies and damages in the area affected, and by projecting these

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1/ See "Green Book," 1950, p. 40 (Ref. 234); and Margolis, J., "Secondary Benefits, External Economics, and the Justification of Public Investment," 1957, p. 284 (Ref. 338).

2/ Volume XIII of the Reclamation Manual, which included instructions for benefit calculations, has been withdrawn, however, and is now being revised.

damage-frequency estimates into the future assuming that the project is not built. Because of the effect of discounting, however, the total value of benefits can vary greatly depending upon what assumptions are made as to the time of occurrence of the future "flood damage." In practice, flood damage prevented (and the resulting flood control benefit) is probably best expressed as an average annual amount derived simply by dividing the total range of probable damage expected during the period of analysis by the number of years involved. 1/

It is to be expected that flood control measures make possible a higher land use and an increased net income, and therefore result in greater capital valuations of property or increased market values. Land or property enhancement may therefore be a dependable measure of flood control benefit--so long as the value attributed to the project represents that portion of the increased value which in fact can be expected to result from the flood control measures themselves. It has been pointed out that when flood control both prevents damage and permits a change in land use, care must be taken to avoid a double counting of benefits. 2/

Hydroelectric Power Generation Benefits

There would seem to be no practical way of computing the true value of power to the user, but for purposes of benefit valuation it can be assumed that the maximum value of the power derived from a particular source is equal to the cost of obtaining an equivalent amount of power from the most economic alternative source (e.g., a privately-owned steam-generating plant operating under public regulation).

The method to be used in calculating the cost of power from the most economic alternative source (and, consequently, the valuation of power benefits) has nevertheless been the subject of controversy. This controversy stems from differing viewpoints with respect to the treatment of taxes and interest charges in comparing public and private power generating costs. A public project which does not pay taxes and pays a relatively low interest charge on its investment often appears, in terms of its unit costs, as preferable to a private undertaking. Thus, if tax and interest charges applicable to a private undertaking are included in determining the cost of the alternative source, power benefits from public water projects may be overstated, and a marginal project may therefore appear more economically desirable than it actually is.

1/ For a discussion of possible variations in the magnitude of flood control benefits resulting from alternative assumptions relative to flood cycles, see White, G.F., "The Limit of Economic Justification for Flood Protection," 1936 (Ref. 389).

2/ "Green Book," 1950, p. 43 (Ref. 234).

For this reason, most studies of the subject recommend that tax and interest assumptions be based on the public undertaking, rather than on a private alternative. 1/ This limitation would seem generally desirable for the sake of conservatism in benefit measurement. In those instances, however, in which firm advance commitments to the State for the purchase of power offer prices greater than the benefit values computed in the above manner, the commitment price ought to be taken as the value of the primary power benefit.

Municipal and Industrial Water Supply Benefits

The same general principles which govern the estimation of power benefits appear for most cases to provide a satisfactory basis for estimating the value of benefit that will accrue to users of water for municipal and industrial purposes. While it might be possible to compute the benefits from industrial water supply in a manner similar to that for irrigation water supply (i.e., by determining value added to production), it is unlikely that a practical method could be devised to compute the benefits from municipal water supply other than by assuming that the water users would be willing to pay an amount for project water up to the cost of obtaining an equivalent supply from the most economical alternative source which could, or would, be employed in the absence of the project. At the same time, care must be exercised in determining this most economical alternative source. 2/ Benefits may well be overstated if it is assumed in all cases that the users would pay an amount for water equal to the cost of the alternative source irrespective of what that cost might be. If the only alternative source is a very costly one, it is unlikely that the quantities of water that could be sold at that price would be as great as the quantities that the project itself is intended to deliver. In the absence of an alternative that is reasonable in cost, it would seem necessary that the benefit value be determined in some other manner (such as an estimate derived from market studies).

Also, as discussed in the case of project power, if the State has received advance commitments from potential users assuring a market for water delivered at a cost greater than the cost computed for the "most economic alternative source," it would seem logical that this higher figure be taken as the value of the benefit.

In view of the conceptual basis of benefits, it would seem necessary in all cases to retain a sufficient flexibility of procedure to permit the use of a method of measurement that is most appropriate to the particular circumstances.

1/ See, for example, Bureau of Reclamation, Report of Panel of Consultants on Secondary or Indirect Benefits of Water-Use Projects, 1952, pp. 46-61 (Ref. 204); and Circular No. A-47, 1952, p. 8 (Ref. 179).

2/ The RAND Corporation, A Brief Survey of the Technology and Economics of Water Supply, 1955 (Ref. 51).

Navigation Improvement Benefits

The benefits from navigation improvement have customarily been described as the savings in transportation costs made possible by the creation (or improvement) of a navigable waterway—by the movement of goods by water transport rather than by more expensive modes of transportation.

The economic advantages (and disadvantages) of water transportation are, of course, well recognized. However, estimates of the monetary benefit to be derived from a projected navigation improvement project (or the navigation improvement component of a multipurpose project) must be based on comparisons of estimated future rail, highway, and water freight rates and on estimates of the future tonnages which will move over the waterway. This is a difficult matter, since other carriers may well adjust their rates to meet the new competition from water transport. As noted by a Hoover Commission task force:

> [estimates of transportation savings (i. e., navigation benefits)] . . . prove to be exaggerated because rate differentials counted upon to divert traffic to the waterway are almost certain to be reduced, if not wiped out, by competitive rate cutting. It is evident that attempts to estimate benefits of this kind involving forecasts of the development of new commerce as well as changes in the pattern of present commodity movements permit grave risks of overoptimism. 1/

Recognizing this fundamental inadequacy of data upon which to base estimates of future benefits from navigation improvement measures, the task force study group concluded that "it is only by the widest of margins of estimated future benefits over costs that economic justification of navigation projects can safely be assumed."

Thus, special care would seem warranted in assessing navigation benefits in projects of the California Water Plan. If these benefits exist at all, they are likely to be quite local in nature and to accrue to a very small segment of the local population. 2/ Although rather substantial benefits have often been ascribed to navigation purposes of federal projects, the fact that those purposes were declared nonreimbursable probably had a good deal to do with the optimism of the project planners. If the navigation improvements were assessed against project beneficiaries, it is likely that the differentials in water and other freight rates would have been far less than estimated.

1/ Task Force Report on Water Resources and Power, Vol. II, 1955, p. 875 (Ref. 210).

2/ For a discussion of economic theory in relation to navigation benefits, see Renshaw, E., "A Note on the Measurement of the Benefits from Public Investment in Navigation Projects," 1957, pp. 652-662 (Ref. 361).

Recreation Benefits

Water projects often result in the creation of important recreational development opportunities. Indeed, under the California Water Plan, recreation is a principal purpose for which certain projects have been proposed.1/ It is readily evident, of course, that recreation is of increasing importance to modern society in general and to the people of the State of California in particular. The demand for and use of recreational areas by the public is growing at an extraordinary rate. Clearly, significant economic benefits result from the inclusion of recreation facilities in water projects, or from making a project area available and open for recreational use.

The primary beneficiaries of a recreation project (or project purpose) include two principal groups. The first is the recreation industry (the individuals to whom new or increased business opportunities accrue); the second consists of the recreationists themselves.

The Department of Water Resources, together with a consulting firm, has developed what appears to be a reasonable method of placing an assumed value on recreation benefits.2/ The method involves a "rule of thumb" estimate of the values that accrue per "recreational-visitor-day." The total benefit amount is then projected on the basis of the number of visitor days expected annually under conditions with and without the proposed project.

Other Benefits

Additional benefits, such as those accruing from fish and wildlife protection, silt control, salinity control, pollution control, and drainage measures, may also result from some water development projects. Essentially, these benefits may be evaluated according to one or more of the principles or methods previously outlined. The benefit from fish and wildlife protection and propagation as it relates to public fishing and hunting can be measured in much the same manner as that of recreation. Where commercial fisheries are involved, however, the benefit ought to be considered as the expected net increase in the value of this commercial production. Salinity control and drainage benefits would seem susceptible of measurement in the same manner as flood control benefits. Certain effects, such as silt control, might best be evaluated in terms of reductions in the costs of maintenance or operation of reservoirs and other facilities (if this were true in a given instance).

1/ See, for example, Bulletin No. 59: Investigation of Upper Feather River Basin Development, 1957 (Ref. 123).

2/ See Bulletin No. 59, Appendix A, "Evaluation of Recreation Benefits," prepared by Harold F. Wise and Associates (Ref. 123). A somewhat similar procedure has been recommended by the Federal Inter-Agency River Basin Committee.

Certain of these "other" benefits may be highly important in a particular project, while in another project they may accrue, in part at least, as a by-product of the project. In any event, unless only a nominal cost is involved, it would seem appropriate to calculate the value of the benefits to be derived if costs are to be incurred in producing those benefits.

Section VI

COSTS

Costs considered in the project formulation process differ in a number of respects from those which have significance for purposes of accounting or bookkeeping. Accounting deals generally with costs which have already been incurred, whereas the economic and financial analyses of proposed projects must deal with costs which are anticipated. Thus, the project planners must view expected future effects in terms of their present value[1/] and must make certain allowances for the risk of prediction. Because comparative analyses are meaningful only when weighed against certain established criteria (i.e., standards of performance), economic and financial analyses must also take into account imputed, or hypothetical, values to a much greater degree than does accounting.

Moreover, as discussed in Section IV, the nature of proposed public investments requires that project planners estimate "economic" costs as well as those costs of a purely "financial" nature. Economic costs relate to the economic analysis of a project; financial costs relate to the financial analysis of a project. It is important to stress this distinction because the two types of cost are employed differently in the planning process and are measured from different points of view.

Economic Costs

Economic costs are the counterpart of economic benefits, reflecting the negative effects of the project just as benefits reflect the positive effects. Economic costs include the value of all resources to be committed to a project (e.g., goods, services, money, and labor), together with the value, tangible or intangible, of detrimental effects resulting from or induced by the undertaking--no matter to whom these various costs and losses may accrue.

It is essential that the benefit and cost data used in the project analyses be mutually comparable. Water resource development planning has often been criticized for stressing the measurement of anticipated benefits without giving similar attention to the measurement of anticipated economic costs. The result has often been that benefits have been overstated while costs have been understated.

1/ As discussed in Section IV, the present values of anticipated benefits, revenues, and costs are determined either by discounting or by converting to average annual equivalents through the application of a suitable rate of interest.

The extent to which economic costs ought to be considered in an evaluation depends upon the extent to which economic benefits are considered. It is not comparable, for example, to measure the secondary and intangible benefits of a project without also taking into account secondary and intangible costs. Similarly, it is inconsistent to weigh the broad economic benefits of a project against only its financial costs. Thus, for clarity, economic costs may be identified as being primary, or direct; associated; secondary, or indirect; and intangible.

Primary Costs

Primary costs (sometimes termed "project costs") include all monetary expenditures expected to be incurred by units of government (federal, state, and local) and by private interests incident to the construction, operation, and maintenance of a project. Therefore, in a State project the cost of any auxiliary facilities, such as distribution and drainage works, transmission lines, access roads, or recreational structures, constructed by private individuals or by the federal or local governments would properly be included in primary costs. In the usual definition, primary costs also include various other costs or losses which will likely result from the project. Examples of such induced costs, as suggested by the Bureau of the Budget,[1] are the costs of:

1. Displacement of people.

2. Decreased value of lands, minerals, water quantity or quality, and other water or related land resources, where not reflected in market values.

3. Rectifying adverse effects upon sanitation, transportation, highway construction or maintenance, or other activities reasonably foreseen as being affected by the program or project.

4. Business losses, such as disruption of trade or diversion of waterborne traffic from existing ports or channels.

5. Losses in state or local tax revenues, adjusted for changes in costs of state and local government services caused by the existence of program or project facilities.

6. Unprevented and uncompensated losses of or damages to fish and wildlife resources; recreation resources; and scenic, archeological, or historical values.

7. Abandonment of economically useful structures, such as locks and bridges.

1/ Circular No. A-47, 1952 (Ref. 179).

Associated Costs

Associated costs are those extra costs which are incurred by the primary beneficiaries of a project in order to realize the full value of project benefits. Associated costs are treated as offsets to the gross primary benefits of a project in deriving the value of the anticipated net primary benefits. The introduction of a supplemental water supply in an agricultural area, for example, may make possible a more intensive cropping pattern. Under the new cropping pattern, however, farmers may incur greater unit and total costs of production and distribution than they previously did, thus offsetting in some degree their increased gross income, or gross primary benefits.

Secondary Costs

Secondary, or indirect, costs are the counterpart of secondary, or indirect, benefits. If it can be assumed that a project will produce secondary benefits such as those that might result from processing an increased agricultural output, then it should also be assumed that partially offsetting costs may be incurred by the secondary beneficiaries in realizing these secondary benefits. If considered in project evaluation, gross secondary benefits must be reduced to a net value by deducting the estimated secondary costs.

Intangible Costs

Intangible costs of a project are those not readily reducible to monetary terms. An example often cited is the destruction of scenic values through project construction. Even though intangible costs are not subject to a dollar appraisal, they nevertheless ought to be taken into account qualitatively in considering the merits of a proposed project.

Financial Costs

For purposes of project formulation, the financial costs of a project are those expenditures--actual and imputed--which the sponsoring government expects to incur in connection with the construction, maintenance, and operation of the project. These costs should be computed without reference to whether or not subsequent reimbursement through revenues or contributions is expected.

Financial costs may be thought of as consisting of "capital costs"[1/] and "operating and maintenance costs." Capital costs are generally those nonrecurring expenditures which are required for the construction of the project from the inception of planning to the completion of

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1/ Capital costs are sometimes referred to as "first costs," "investment costs," or "fixed costs."

construction. Operating and maintenance costs are those which recur continuously or periodically incident to project operations.

Capital Costs

Capital costs generally deemed chargeable to water resource development projects include actual or imputed expenditures for:

1. Economic, engineering, legal, and other planning studies and investigations related to the project (including those to be undertaken prior to project authorization).

2. Materials, supplies, utilities, labor, and services during construction (including administration, supervision, and maintenance).

3. Interest accrual during construction.

4. Acquisition of land, easements, rights-of-way, and water rights.

5. Relocation of facilities, such as railroads, highways, and utilities.

6. Compensation for damages and payments of damage claims.

7. Funds established for contingencies and cash working capital.

8. Funds established for major replacements and additions during the life of the project.

9. Works and services provided during construction for the protection of public health and safety, the prevention of losses and damages, and the restoration of damaged properties and values.

The gross capital cost of a project is the sum of the above costs, together with any similar costs that are appropriate. The net capital cost is the gross amount less any allowance for salvage value remaining beyond the period of project analysis. The extent to which anticipated salvage values are considered has an important bearing on findings of financial feasibility. Since net capital costs are reduced as salvage value estimates increase, feasibility requirements also become less stringent.

The treatment of salvage value in federal projects has been the subject of considerable debate. In some instances, salvage credits have been estimated on the assumption that the fixed assets of the project will have a value for project purposes beyond the period of analysis. Most study groups recommend, however, that assets remaining at the end of the period of analysis be valued only in terms of their nonproject uses (i.e., scrap value) and that all assets be regarded as being fully depreciated for project purposes during the period of analysis.

Operation and Maintenance Costs

Operation and maintenance costs are those that recur throughout the lifetime of a project, such as the costs of electric power for pumping, materials and supplies used in maintenance and repair, project administration, and general labor. In addition, it may be desirable for planning purposes to include certain hypothetical charges which would be incurred if the project were a private enterprise (e.g., annual allowances for "taxes" and for general administrative expenses). These artificial charges have been the subject of some controversy, however, and are therefore worthy of further study.1/

Certain operating and maintenance expenses vary directly with the volume of production (i.e., quantities of water and power delivered). Other items of operating expense, such as those of an overhead nature, remain relatively constant.

Annual Allowance for Capital Recovery

In the project formulation process, the discounting of all values to their present worth or their conversion to average annual equivalent values implies that the original capital costs plus an appropriate return on investment will be recovered over the economic lifetime of the project. This is true even though the actual methods of depreciating capital assets and amortizing capital costs are accounting problems which are irrelevant for purposes of project formulation. If, however, a project is to be financially feasible, repayment schedules must provide for annual allowances for capital recovery

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1/ Most federal agencies impute a tax charge equal to payments that would have been made had the project not enjoyed a tax-free status. The reasoning here is that tax immunity agreements are intergovernmental and do not extend to private individuals. By building a project, government foregoes tax receipts that would have been collected had the construction been accomplished by private enterprise. While these imputed charges would seem proper as elements of economic cost, their inclusion in financial cost seems questionable.

which will take account of (1) amortization of the net investment, and (2) a return on the gross original investment consistent with the interest (i.e., discount) rate used in project formulation. This must be done, moreover, regardless of whether the money actually used in the first instance to pay for the capital assets is obtained from taxes or by borrowing, and irrespective of the interest rates actually paid on any money borrowed. 1/

That the government should seek a return on its investment is sometimes difficult to understand, particularly if the capital to be invested is obtained from current revenues rather than by borrowing. When borrowed money is to be invested, the interest to be paid for that money is clearly an item of expense chargeable to the enterprise. It is less obvious that an interest expense is also incurred when current funds are the source of the investment capital.

The term "interest" has, however, a broader meaning than that implied in an accounting sense. Interest is a measure of the rate of return on invested capital, an expression of the time value that money has, and an indicator of the earning capacity of capital. Capital can be loaned at interest or otherwise invested productively to generate return.

An objective of investment is a return of capital "plus interest." The layman is sometimes unwilling to accept this concept, however, in viewing a proposed public undertaking. Because he tends to view costs in their strict accounting sense, he feels that the use of current funds in a public enterprise is somehow "interest free." His reasoning fails to recognize that an economic loss results whenever interest is waived on the use of public funds. Government incurs a cost in the sense that it has foregone an opportunity to earn interest in an alternative investment or to save interest by retiring some of its interest-bearing debt. The individual taxpayers have incurred costs in the same sense--taxes or revenues collected from them might otherwise have been invested for private gain.

The actual rate at which the State may seek to recover the capital costs depends upon the repayment period selected and the method of depreciation employed for accounting purposes. It is not necessary that actual repayments in any one year coincide with the average annual

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1/ All federal water resource agencies provide for a return on their capital investment in this manner. The Department of Agriculture, the Corps of Engineers, and the Federal Power Commission apply the interest to the gross investment amount, whereas the Bureau of Reclamation considers the net investment amount (i.e., gross investment less salvage value) as the principal. The Bureau, however, also applies the same interest charge to the allowance for salvage value, in effect providing for a return on the gross investment amount.

equivalent costs computed in project planning. The planning figure merely serves as a guide. If the State should choose a method of depreciation in which fixed assets are written off in somewhat equal annual amounts (e.g., straight-line depreciation), and if the rate of return is computed on the basis of the total original investment, annual repayment amounts will approximate the average annual costs determined in project formulation.

Rather than recovering capital costs in equal annual amounts, however, the State may prefer to amortize these costs for accounting purposes in amounts which either decrease or increase progressively each year. In the former case, a greater proportion of the total cost is amortized in the earlier years of project operations, thus providing added protection against risk. The latter approach, however, would offer the administrative advantage of allowing the State to increase its charges to project beneficiaries gradually. It cannot be expected that a project's capacity will be fully utilized from the moment that its products and services become available. Rather, there will be a period of perhaps a number of years over which the demand for these products and services will develop to its full extent. While no method of amortization can be expected exactly to parallel this growth trend, a method that permits a gradual increase in repayment requirements offers a means of providing for such a development period.

Section VII

COST ALLOCATION

Initially, public water resource developments were single purpose projects and posed few problems in determining costs or assigning repayment responsibilities. The emergence of the multipurpose project, however, has complicated the project evaluation process and the assignment of repayment responsibilities in that certain project costs cannot be identified positively with any particular project purpose. This section of the report therefore considers the role of cost allocation in public water resource development, discusses certain principles of cost allocation, and describes various methods of cost allocation that the State of California may wish to consider in developing its water resources program.

The Role of Cost Allocation

Those elements of the cost of a multipurpose project that can be identified positively with the individual project purposes are termed "separable" costs. Elements of cost that are incurred in connection with the over-all operation and cannot be identified with a given project purpose are termed "joint" costs. The separable cost attributable to an individual project purpose is the difference in the total cost of the project with the purpose included and with the purpose excluded. In other words, the separable cost of a project purpose is the additional total cost of the project over what that total cost would have been if that project purpose had been excluded. The joint costs of a project are the residual costs remaining after all separable costs have been identified.

A multipurpose water project is not unlike a private manufacturing enterprise which produces a number of products. The manufacture of multiple products complicates cost determination as well as decisions that depend on cost determination. In decisions that relate to a particular product, however, the most significant cost factor is the separable cost of that product.1/ Joint costs,2/ by definition, cannot be identified with a specific product and are therefore relevant mainly to decisions

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1/ Separable costs include more than the costs directly attributable to a product, such as the cost of an item of machinery used in the manufacture of the product; they include all added costs of increasing the over-all size and capacity of the manufacturing plant, or modifying its design, or changing its operating procedures.

2/ Joint costs may be either common overhead costs, which are indirectly associated with a product (e. g. , costs of administration), or common production costs (e. g. , costs of common materials, equipment, or processing).

on the over-all operation. The separable cost of a product is the minimum that must be recovered through the sale of that product if the product is not to be produced at a loss. Since joint costs must be recovered from the operation as a whole, it is not essential to distribute those costs among the various products in arriving at production decisions with respect to individual products or in establishing initial pricing policies for those products.

In those instances in which a private enterprise does undertake to distribute joint costs among products, it does so mainly for purposes of internal accounting, budgetary planning, performance evaluation, or for other administrative reasons. Although the methods of allocation are necessarily arbitrary, joint costs are usually allocated in proportion to the revenue expected from each product so that the allocations will be consistent with asking prices. 1/

Just as in private enterprise, the allocation of the joint costs to the various purposes of a public water project is an administrative, rather than an economic, requirement. For example, the price at which project water is sold need not depend upon cost allocation, even though at the planning stage it may be anticipated that the water supply purpose will produce sufficient revenue to cover its separable cost.

In practice, however, cost allocation may provide a framework within which cost recovery arrangements may be planned. If properly accomplished, cost allocation also provides a means by which the economic and financial aspects of individual project purposes can be analyzed and evaluated during project formulation. Further, it provides a means by which the economic and financial merits of individual project purposes can be judged and weighed in the administrative or legislative justification process. 2/ Finally, it provides a means by which the economic and financial performance of each project purpose can be audited and re-evaluated periodically after project operations have commenced.

It should be understood that costs allocated prior to project construction are anticipated discounted costs estimated for planning purposes. For purposes of economic analysis, economic costs are allocated,

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1/ If, however, expectations are not fulfilled, costs may be reallocated so as to be consistent with the prices actually obtainable in the market.

2/ The ever-present need of government to justify its actions is often overlooked in comparisons of government enterprise with private enterprise. Cost sharing arrangements for public water projects, for example, must in practice be justified to the satisfaction of the general taxpayer and the various governmental bodies, governmental agencies, and beneficiary groups involved. While the justification process and its requirements are not dealt with extensively in this report, these considerations are nevertheless important from an administrative and legislative point of view.

and for purposes of financial analysis, financial costs are allocated. Once a project is in operation, however, cost allocations deal with actual accounting costs.

Principles of Cost Allocation

Any method that the State of California might select for assigning costs in its multipurpose projects will result in an allocation that is essentially arbitrary. The degree of arbitrariness may be reduced, however, by selecting or devising a method which is based on recognized economic and ethical principles.

From the standpoint of economics, an acceptable method is one in which:

1. Costs allocated to any project purpose will at least equal the separable cost of that purpose.
2. The sum of the costs allocated to all project purposes will equal the total cost of the project.
3. Total costs allocated to a particular purpose (as a basis for project repayment) will not exceed the value of the benefits to be derived from that purpose.1/

From an ethical standpoint, an acceptable method would seem to be one which permits all project purposes to share in the savings that have resulted from multipurpose rather than single-purpose construction, and otherwise distributes costs among project purposes in a reasonable and impartial manner.

Various Methods of Cost Allocation

After an extensive review of federal agency cost allocation practices, the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee recommended in 1950 that a new allocation method be adopted by all federal water resource development agencies.2/ The new method, known as the separable costs-remaining benefits method, has received wide recognition and general acceptance as the

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1/ If allocated costs exceed the benefits of a project purpose in the economic analyses, there is a presumption that the inclusion of that purpose in the project is not economically justified (i. e. , it fails to meet the test of economic feasibility).

2/ See "Green Book," 1950 (Ref. 234).

preferable cost allocation procedure.1/ The method will be discussed in some detail later in this section. First, however, other methods that have been commonly employed in public water resources development will be considered.

1. The Benefits Method. The benefits method allocates costs among the various project purposes in proportion to the value of the benefits produced by each purpose. In one variation, all costs are assumed to be joint costs and are allocated among the purposes in direct proportion to the value of their benefits. In another variation, "direct costs"2/ are first identified with their respective purposes, and the remaining "costs of joint facilities"3/ are allocated in proportion to benefits.

2. The Separate Projects Method. In the separate projects method, costs are allocated in proportion to what the costs of obtaining equivalent benefits would have been if separate, single-purpose projects had been built to serve each purpose. In the first of three variations, all costs are regarded as joint costs and allocated accordingly. In the second, direct costs are first identified and the remaining costs of joint facilities are allocated in proportion to the difference between the estimated cost of the alternative single-purpose project for each purpose and the direct costs of that purpose. The third variation is similar to the second, except that separable costs rather than direct costs are used.

3. The Alternative Justifiable Expenditure Method. In this method, the costs of joint facilities are allocated in direct proportion to the "remaining alternative justified investment" for each project purpose. This investment amount is defined as the smaller of either (1) the cost of the most economical alternative single-purpose project which will produce equivalent benefits--less any direct costs, or (2) the total value of benefits ascribed to the purpose--less any direct costs.

1/ See, for example, Ablin, R., "The Problem of Cost Allocation in Multiple-Purpose Water Use Projects," 1956 (Ref. 455).

2/ Direct costs, which are the costs of specific features or physical facilities wholly devoted to a particular function or purpose, are not the same as separable costs. Direct costs constitute only a portion of the true separable costs.

3/ The costs of joint facilities are the costs of those specific features, such as a dam, that serve more than one project purpose. Some of the costs of these joint facilities, however, are capable of being identified with individual project purposes and, to that extent, are actually separable costs. In a given project, the true joint costs are less than the costs of the joint facilities.

4. The Vendibility Method. This method allocates costs in proportion to the market prices of the project commodities or services. To the extent that the market price can be considered equivalent to per-unit benefits, the method and its variations are similar to those methods which use benefits as the allocation determinant.

5. The Use of Facilities Method. This method is based on the concept that the cost of joint facilities should be allocated among the various purposes in proportion to their respective "use" of those facilities. "Use" is measured either in terms of the storage capacity provided for the purpose, or in terms of the quantity of water flow, or both.

6. The Priority of Use Method. The premise of this method is that the various purposes compete with each other to some extent for the use of water flow capacity or storage space. Some purposes are regarded as having priority over others, and the method is designed to give special attention to these priorities. The method identifies direct costs with their respective purposes and allocates the costs of joint facilities in a descending order of priority. The purpose with the highest priority is assigned only its direct costs plus a share of the costs of joint facilities equal to the lesser of either (1) the benefits less direct costs or (2) the cost of the most economic alternative project less the direct costs of the purpose.

7. The Incremental Method. This method identifies separable costs with their respective purposes and allocates all joint costs to that single purpose which is considered the primary function of the project.

8. The Direct Costs Method. This method is a variation of the incremental method, except that direct costs rather than separable costs are employed, and the costs of joint facilities, rather than joint costs, are allocated to the primary project purpose.

9. The Equal Apportionment Method. In one variation, separable costs are identified, and in the other variation direct costs are identified. Depending on the variation used, either joint costs or the costs of joint facilities are apportioned equally among the principal purposes of the project.

None of the methods described in the numbered paragraphs above is wholly satisfactory in view of the basic principles of cost allocation previously discussed, although some are more acceptable than others. From an economic standpoint, a method that identifies separable costs

is preferable to one that identifies only direct costs. In recognizing only direct costs, a method identifies part, but not all, of the costs of adding the project purpose. Since there may be a substantial difference between the values of the direct and separable costs, there is no assurance that the costs allocated to a purpose will at least equal its separable costs when direct costs are used as a determinant.

In applying the use of facilities method, practical difficulties have arisen in defining and measuring the extent to which each project purpose uses the joint facilities. The amount of storage capacity allotted for flood control purposes might be a measure of that purpose's proportionate use of the joint facilities. For irrigation water supply purposes, however, the quantity of water to be made available for that purpose might be a better indicator of use. For power generation, both storage capacity and water flow are important. Moreover, the same storage capacity or water flow actually may be used for several purposes simultaneously. Thus, there is no scientific way of measuring on a comparable basis the amount of "use" that each function makes of joint facilities, nor is such a measurement of economic consequence. The various project purposes do not necessarily derive economic value from the use of joint facilities in proportion to storage capacity or to a given quantity of water flow. Thus, there is no assurance whatever that costs allocated to a particular purpose in establishing repayment arrangements will not exceed the benefits, nor is there assurance that separable costs will be covered.

By allocating costs in proportion to the market price of project commodities and services, the vendibility method attempts in general to follow private enterprise practices. It is applicable, however, only to those project purposes furnishing products or services that are commercially marketable and for which a market price can be determined. Some project purposes, such as flood control, provide services that are not commercially marketable. If these purposes are to share in cost allocations, some determinant other than market price must be used.

Those methods that depend on calculations of the costs of alternative projects would seem to be particularly unreliable. There is usually insufficient data readily available with which to compute the costs of these rather hypothetical alternatives, at least with a proper degree of reasonableness. Although it is necessary and desirable early in the project formulation process to determine that the project finally selected is in fact more economical than any other practical alternative, it would not seem necessary that this consideration enter, and unduly complicate, the cost allocation process. It seems probable that these techniques were devised primarily as administrative devices to help ensure that alternative projects were considered adequately by project planners.

Methods that allocate joint costs to purposes in proportion to the value of their benefits are to be preferred to those that allocate joint costs in any other manner. The most dependable guide to the allocation of joint costs in private enterprise is revenue; the comparable guide in public enterprise ought to be the value of benefits.

The Separable Costs-Remaining Benefits Method

The separable costs-remaining benefits method (referred to as the SC-RB method) is a modification of the alternative justifiable expenditure method, differing primarily from the latter by identifying separable, rather than direct, costs. Its objective is to allocate costs in such a manner that (1) each project purpose will at least be allocated its separable costs; (2) the total costs allocated to any purpose as a basis for repayment will not exceed either the benefits of the purpose or the costs of providing the same benefits by the most economic alternative project; and (3) within these maximum and minimum limits, a proportional sharing of the savings from the multipurpose development will result.

When used as a basis for repayment arrangements, this method cannot result in an allocation of anticipated cost to a particular purpose that is greater than the benefits expected to be derived from that purpose or that is less than the expected separable cost of that purpose. In the application of the method, the separable cost of each purpose is determined by computing the cost of the total project with the purpose included and, again, with the purpose omitted. The difference in these total cost figures is the separable cost attributable to that particular purpose. After all of the separable costs have been determined, joint costs are allocated among the various project purposes in direct proportion to the "remaining benefits" ascribed to each purpose.

For purposes of project formulation, remaining benefits are the total discounted money value of the benefits expected from each purpose (limited by the cost of the "most likely economically feasible alternative source available") less the separable costs expected for that purpose. The following tabulation illustrates the method of allocating joint costs:1/

Item	Discounted Values of Items (thousands of dollars)				
	Flood Control	Power	Irrigation	Navigation	Total
1. Benefits	500	1,500	350	100	2,450
2. Costs of alternative project	400	1,000	600	80	2,080
3. Adjusted benefits (lesser of items 1 and 2)	400	1,000	350	80	1,830
4. Separable costs	380	600	150	50	1,180
5. Remaining benefits (item 3 less item 4)	20	400	200	30	650
6. Allocated joint costs	18	360	180	27	585
7. Total allocation (item 4 plus item 6)	398	960	330	77	1,765

1/ "Green Book," 1950, p. 55 (Ref. 234).

As the tabulation shows, the joint costs allocated to each project purpose (item 6) are in the same proportion to total joint costs as the remaining benefits of each project purpose (item 5) are to the total remaining benefits. 1/ The total cost assigned to each project purpose (item 7) is the sum of the separable cost (item 4) and its allocated share of the joint cost (item 6). 2/

Although the method has weaknesses which will be discussed subsequently, it follows sound economic principles and, at least in theory, results in a reasonable and fair cost allocation. In general, it would seem suitable and appropriate for use by the State, particularly in view of the fact that its adoption would make for uniformity in the State's dealings with the federal government.

Weaknesses of the Separable Costs-Remaining Benefits Method

The principal weakness of the SC-RB method lies in the measurement of its determinants. As discussed in Section V, the varying nature of the different project purposes renders benefit measurement on a comparable basis difficult. To the extent that these bases cannot be clearly defined or are not realistic, calculation of benefits can be used to manipulate the allocation method. 3/ In spite of the difficulties in measuring benefits, there does not appear to be a more suitable determinant for allocating costs. The closer that measurement of anticipated benefits can come to predicting the true value of a project's commodities and services, the more sound will be the cost allocation method.

1/ The method does not, as it is sometimes assumed, assign total costs in proportion to benefits.

2/ It is possible that the total separable costs of all purposes might exceed the total cost of the project. In this event, there are no joint costs to be assigned. Instead, there is a joint saving to be distributed that reduces the separable cost of each purpose.

3/ In its audit of the Central Valley Project, the Comptroller General of the United States reported the following finding: ". . . we believe that allocation of the construction cost of the Central Valley Project to navigation is subject to question.

"The tentative allocation. . . was made in accordance with the separable costs-remaining benefits method. . . our review showed that the Bureau [of Reclamation] had not identified any project construction costs which were incurred solely for the navigation purpose; statements by Bureau officials. . . indicated that without the navigation purpose other project functions would require very closely the same quantity of storage and related releases, so that the elimination of the navigation purpose from the project would not result in any significant changes in the existing project facilities.

"Since [it was] determined that $1,325,400 of estimated annual benefits to navigation interests would result from the operation of

The other determinants of the method which are highly subject to inaccuracies of computation are the separable costs and the alternative project investments. Both determinations require a series of complicated, hypothetical calculations. The determination of separable costs, however, is essential to any acceptable method of cost allocation and therefore warrants an effort sufficient to obtain a reasonably accurate estimate. Calculation of the alternative project investment, however, would seem to be a different matter. So long as adequate provision is made elsewhere in the formulation process to ensure that alternative project possibilities are given due consideration by project planners, it would seem unnecessary to complicate unduly the cost allocation process in this regard. The extent to which benefits may be considered in the benefit-cost analyses, for example, is not limited in this manner. Thus, modification of the SC-RB method by dispensing with the calculation of the costs of alternative projects might be given consideration by the State. 1/

A further weakness of the SC-RB method may be that it allocates joint costs to any project purpose to which benefits are ascribed, even though no separable costs are incurred in incorporating that purpose in the project. For example, a water supply reservoir may incidentally provide a certain amount of flood protection although it is not designed for flood control and no separable costs are incurred in realizing the flood control benefits that may nevertheless accrue. Even in this instance, however, the SC-RB method permits the allocation of joint costs to "flood control." This facet of the method would seem to be a source of potential abuse unless the allocation of joint costs is restricted to those project purposes for which separable costs have been incurred.

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the Central Valley Project, the separable costs-remaining benefits method of allocation. . . would necessitate an allocation of some costs to that purpose. As it had been determined that no separable cost could be assigned to the navigation purpose, only a portion of the joint costs which relate to all purposes of the project could be allocated to navigation. This portion of joint costs allocable to navigation in the study reviewed by us was determined by the Bureau to be $12,940,000.

"The navigation benefits used in the construction cost allocation reviewed by us were computed in 1947 based on studies and analyses made in 1943, which in turn utilized statistics some of which were obtained prior to World War II. . . After about 15 years from the date of the completion of the original study, traffic has not developed proportionately as estimated."--Audit Report to the Congress of the United States, 1957, p. 57 (Ref. 213).

1/ For a suggestion along these lines, see Ablin, R., "The Problem of Cost Allocation in Multiple-Purpose Water Use Projects," 1950 (Ref. 455).

Consistency in the Use of Allocation Methods

While the SC-RB method has received general endorsement by all federal agencies and will likely serve as a basis for standardizing federal cost allocation procedures, existing inter-agency agreements also permit continued use of the alternative justifiable expenditure method (where separable costs "cannot readily be determined") and the use of the facilities method (where that method is "consistent with project objectives" and where proportional use is "readily determinable for all purposes and on a comparable basis"). 1/

A method for assigning costs in a multipurpose project is essentially a statement of certain economic and ethical principles. If this statement is complete and clear, the resulting method of allocation is unique and fixed. The basic principles that it expresses are either accepted or they are not. The use of different methods or combinations of methods for different projects or different parts of the same project reflects either an uncertainty of policy or a manipulation of a given policy to meet the expediencies of a particular situation. Obviously, consistency of policy means consistency in the method used for all cost allocation purposes. 2/

In addition, consistency of method requires that all costs be allocated, regardless of whatever arrangements may exist for cost sharing or whether or not certain costs may be declared nonreimbursable. In other words, it is not proper in cost allocation to deduct prior to allocation those costs to be absorbed by an agency other than the sponsoring agency or those costs to be borne by the general taxpayer. One of the principal functions of the cost allocation process is to provide a full and clear disclosure of project costs, regardless of reimbursement provisions.

1/ These various agreements, expressed in the form of departmental memoranda, are apparently compromise measures. The Bureau of Reclamation, for example, has opposed sole use of the SC-RB method. As discussed in Section V, the Bureau credits to the irrigation purpose of its projects the monetary value of certain secondary benefits. While the increased value of benefits thus derived is helpful in project justification, it works to the detriment of the irrigation purpose in cost allocation because the SC-RB method allocates joint costs in proportion to "remaining benefits." Thus, those purposes showing a greater value of benefits receive generally a correspondingly greater allocation of cost.

2/ If the State should adopt the SC-RB method, for example, it would be inconsistent to use that method in allocating the cost of a dam, say, and a wholly different method in allocating the cost of an aqueduct system. (Tentative allocations of cost for the Feather River Project thus far published by the Department of Water Resources are, in general, based on a concept of proportionate use of facilities.)

As will be discussed in the next section of the report, it may become necessary and desirable for the State, in establishing repayment schedules, to reallocate at least the financial costs of reimbursable project purposes according to the geographical location of the beneficiaries (i. e., the contracting agencies or other beneficiary groups) of those purposes. Again, consistency of policy would seem to require that apportionment of costs geographically be accomplished by the same method used in allocating costs to project purposes. Thus, if the State should adopt the SC-RB method in allocating costs to project purposes, then it should also use the SC-RB method in determining costs allocable to a particular contracting agency as a basis for repayment. In this event, the separable cost assignable to a particular contracting agency would be determined by computing the total cost of the project purpose with and without service to that agency. Joint costs, if any, would be assignable to that agency in proportion to the value of that agency's "remaining benefits."

Section VIII

REPAYMENT OF FINANCIAL COSTS

The State of California has not as yet established a policy with respect to the reimbursability of project costs, nor has it determined the manner in which prices, rates, and charges are to be computed and collected from project beneficiaries incident to the recovery of costs.

While the cost allocation process may serve as a framework for repayment arrangements, the State must decide whether it intends that the costs allocated to each project purpose will be repaid in full, in part, or not at all by the beneficiaries of those purposes. Once these decisions have been reached, the way in which project costs will be repaid must be determined. Until these matters are resolved, project planners will be unable to undertake proper demand analyses, to estimate the benefits expected to accrue from certain project purposes, or to assess project feasibility.

This section of the report therefore discusses certain conceptual approaches to project repayment, considers cost recovery in relation to the various project purposes, and examines specific procedures that the State might employ in effecting repayment of costs from beneficiary groups.

The Question of Nonreimbursable Costs

In the case of any government-sponsored water development project, an approach with respect to repayment could vary from requiring total repayment to no repayment at all.1/ Moreover, because of the multipurpose nature of most projects, the degree of repayment could also vary among the various project purposes. To the extent that repayment requirements for a project or project purpose are less than the total financial costs of the project or project purpose, however, the beneficiaries receive a subsidy.

A requirement that the identifiable beneficiaries of each project purpose repay the government in full would not necessarily rule out water resource development by government. There may be parts of multipurpose projects which, although they are reimbursable in full, are reimbursable over such a long period of time and/or at such a low return as to be uninteresting to private enterprise. At the same time,

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1/ For a discussion of these approaches and their relation to the policies of the federal government, see The Report of the President's Water Resources Policy Commission, Vol. I, 1950, p. 67 (Ref. 239).

a requirement for full reimbursement would tend to prevent the authorization of unsound projects, would minimize the general tax burden, and would largely eliminate the possibility of unjustifiable subsidies. Moreover, if each project is formulated properly on the basis of clearly identifiable direct benefits and reasonably accurate estimates of the economic demand for its products and services, the beneficiaries of each project purpose ought to be able to repay the costs allocated to that purpose.

On the other hand, government may decide that certain project purposes are "in the public interest" and not require the beneficiaries to repay all of the costs of providing the benefits they receive. The government may consider, in other words, that the indirect benefits expected to accrue to the general taxpayers as the result of incorporating certain purposes in a particular project are sufficiently great to make a subsidy worthwhile in that case. In other instances, regardless of considerations of economic benefit, the government may consider that for such reasons as public health, safety, and defense, it has some responsibility (social or other) to share in the costs of certain project purposes of specific projects. Finally, even though government may wish to do so, there may be practical difficulties in obtaining full repayment from the beneficiaries. It may be either impossible to identify those beneficiaries for purposes of repayment or, if they can be identified, there may be no practical means of collecting from them.

The fact that the State of California is a political and not an economic entity, however, suggests that the general taxpayers are unlikely to receive sufficient economic benefit from the State's water development projects to make a State subsidy worthwhile purely on economic grounds. Within the individual economic regions of the State, however, sufficient economic benefit may accrue to persons other than the direct project beneficiaries to warrant their participation in project repayment at the local level.

Thus, it would seem that only a practical inability to effect repayment in a given case or an assumption of a social (rather than economic) responsibility would constitute premises under which it might be necessary or logical for the State to forego repayment of certain of the costs of a project. Moreover, if the objective of the State is to achieve the most economic allocation of its water resources, the government of the State of California should seek to minimize subsidies on whatever premise, and should lean as far in the direction of requiring full reimbursement as practicable. Preferably, the general taxpayers of the State ought not to be asked to subsidize the project beneficiaries, nor should the beneficiaries of one project purpose be asked to subsidize the beneficiaries of another project purpose. If repayment can be

arranged, the beneficiaries of each project purpose should repay in full over the lifetime of the project the costs allocated to the project purpose from which they benefit. 1/

The Distinction Between Project Financing and Repayment

Before proceeding to a discussion of the repayment aspects of the various project purposes, it is necessary to emphasize certain distinctions which are relevant to what will follow. The first is the distinction between project financing and project repayment.

Project financing involves the provision of funds needed to meet project costs at the time when they occur. It may require the sale of general obligation bonds (which involves underwriting by the general taxpayer), the collection from the general taxpayer of additional tax revenue, or the commitment of certain special funds (which "belong" in fact to the general taxpayer). Project repayment involves the recovery of project costs over the lifetime of the project through the payments of project beneficiaries. In effect, as the project facilities are used, the project beneficiaries repay the taxpayers of the State for financing the construction of the facilities in the first place. 2/

The distinction between the general taxpayer and the project beneficiary is an important one. The general taxpayers are the "stockholders" of the "corporation"; the project beneficiaries are the "customers" who purchase the "corporation's" products and services. Unless subsequently disposed of, then, project facilities constructed by the State and the revenues derived from those facilities belong to the general taxpayer. Moreover, it is not necessary for purposes of project financing that beneficiaries commence repayments to the State in advance of project construction. Such a requirement would be no more logical, for example, than if a private corporation were to require advance payments from its customers for goods expected to be supplied at some future date after necessary production facilities were constructed.

1/ This is not the same as saying that the share of the costs to be borne by the beneficiaries should be proportionate to the benefits received. The benefits of fresh water to municipal water users and of hydroelectric power to power users may exceed the costs by a ratio which is considerably greater than the ratio by which the benefits of irrigation water to farmers exceed the costs. Whether or not the costs and the benefits of different uses are proportional is irrelevant to the proposition that the beneficiaries should pay whatever costs are incurred in making the benefits available.

2/ The taxpayers who are eventually repaid, however, may not be the same generation of taxpayers involved in the original financing. For this reason, it may be more equitable for the project to be financed by the sale of bonds rather than by current taxes.

Project beneficiaries, however, are also general taxpayers, and this dual role has tended to confuse the current public debate concerning the Feather River Project. In certain cases, potential beneficiary groups have felt that (as general taxpayers) their tax contributions to project financing result in their "ownership" (as project beneficiaries) of a certain portion of the physical facilities as well as in their being given cognizance over the revenues to be derived from that portion of the facilities. In other cases, beneficiary groups have assumed that advance payments to the State are somehow essential to project financing. Thus, again, it seems important to emphasize that the general taxpayers (whether or not they are also project beneficiaries) will finance initial project construction and that they may be repaid, in full or in part, by the project beneficiaries over a period of years after project operations have commenced.

The Distinction Between Repayment Planning and Actual Repayment

There may be a difference between the repayment policy which is planned when a project is being formulated and the repayment policy which turns out to be the most economic after the project is constructed. Before actually incurring the costs allocated to, say, a water supply purpose, the State may plan to recover all costs from the beneficiaries of that purpose. After the project has been constructed, however, the State may find that some of its anticipations were incorrect and that net benefits can be maximized (in either the short or the long run) only if the original repayment schedule is revised--a point which will be illustrated later in this section.

As indicated in Section IV, a somewhat arbitrary period of repayment must be selected for purposes of project planning. Ideally, however, project beneficiaries should repay only over whatever period of time turns out in fact to be the genuine lifetime of the project. A repayment dilemma may therefore arise if the planned repayment period is either too long or too short. If the true economic lifetime turns out to be shorter than anticipated, someone will have to continue to pay for the project facilities after they are no longer as useful as anticipated. On the other hand, if the economic lifetime turns out to be longer than anticipated, the State will be forced either (1) to reduce the capital cost repayment obligations of the project beneficiaries (thus implying that prior beneficiaries were overcharged) or (2) to continue to operate the project at a "profit" (thus overcharging all the beneficiaries regardless of the point in time when they benefited). Presumably, however, this question of repayment policy need not be answered before the project is built.

In this connection, it has been proposed that project receipts not needed to retire bonds sold for current project financing be set aside in a special water development fund to be used in the financing of future water projects. This may well be a sound approach to project financing, but it is not relevant to project repayment as such. Even if all of the

capital costs of projects were financed out of current taxes (rather than by the sale of bonds), a cost recovery or repayment policy would still be needed. It would still be necessary for the State to decide whether the project beneficiaries should repay the taxpayers of the State in full, in part, or not at all. Furthermore, particularly if the project is financed by the sale of bonds, a water development revolving fund supplied only by project revenues would "revolve" over such a long period of time as to be of relatively little use in financing projects during the earlier years of the program.

The Distinction Between Fixed and Variable Costs

A distinction is also to be drawn between (1) those project costs which are fixed in the sense that, after initial construction and over the lifetime of the project, they are unrelated to variations in project output, and (2) those costs which will vary depending upon project output. The fixed costs (i. e. , annual capital charges) will continue to accrue and must be paid regardless of whether or not there is any project output, while annual operation and maintenance costs will vary in some relation to project output.

This distinction may be important in planning for the repayment of costs allocated to project water supply purposes. It may also be an important consideration in establishing the actual mechanism of repayment, since, once the fixed costs of the project have actually been incurred, the State may be unable to find local agencies which will then be willing to undertake the repayment of those costs. Indeed, if the State intends to recover costs from project beneficiaries, it will probably have to enter into repayment contracts with the beneficiary groups <u>before</u> the fixed costs are actually incurred. This would seem particularly necessary for such project purposes as flood control in which the construction of the facilities, rather than their operation, provides most of the benefit value.

Repayment by Project Purpose

Since it is the particular nature of the individual project purposes that might influence the State's decisions with respect to the reimbursability or nonreimbursability of certain costs, there would seem to be no logical basis for declaring nonreimbursable any capital costs that relate to a project as a whole. 1/

1/ For example, it has been suggested in discussions concerning the California Water Plan that the costs of acquiring land, easements, and rights-of-way for projects be declared nonreimbursable. This reasoning apparently stems from provisions in the Flood Control Fund Act of 1946 which authorize State financial contributions for certain federal flood control projects equal to the cost of acquiring land, easements, and rights-of-way. It should be recognized,

Flood Control

The policy of the federal government with respect to the reimbursability of flood control projects has fluctuated over the years. In general, however, the federal government has never made an effort to collect substantial contributions from the direct beneficiaries. Federal disposition in recent years, however, has favored requiring more, rather than less, local participation to secure project authorizations.[1]

By the federal Flood Control Act of 1936, local beneficiaries are required only to (1) secure and pay all costs for lands, easements, and rights-of-way, (2) relocate or reconstruct all bridges, structures, and utilities, (3) assume certain responsibilities for operation and maintenance of the project, and (4) hold the government free from damage claims.

Direct beneficiaries of federal flood control projects constructed in California, however, have been further relieved of any substantial burden of repayment. The Flood Control Fund Act of 1946 authorized the State to reimburse local interests for the costs of acquiring lands, easements, and rights-of-way required for federal projects, as well as for all of the costs of relocating or reconstructing bridges, structures, and utilities. But this policy was formulated in connection with State participation in federal projects, and the State must now decide upon the extent to which local interests are to participate in the repayment of State-sponsored flood control works.

It can be argued that the State has a responsibility in the interests of public health and safety to participate in the costs of providing flood control. At the same time, the economic benefits by which a flood control project may be justified are largely private and local--benefits which contribute to the increased property values in the area which might otherwise be flooded--and it is unclear how these economic benefits alone can be made the basis for justifying contributions by the general taxpayer to the cost of flood control works.

An important consideration is whether the federal government is prepared to pay for the costs of a State project which are allocated to flood control. But even if federal funds should be forthcoming, it would

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however, that these costs may constitute a substantial portion of the total costs of a given project, and that they are elements of capital cost properly allocable to the various project purposes in the same manner as other elements of capital cost. They should be regarded similarly, therefore, for purposes of repayment.

1/ On this subject, see in particular Task Force Report on Water Resources and Power, Vol. II, 1955 (Ref. 210).

appear reasonable for the State to allocate costs to flood control without reference to possible federal financial assistance, and to decide for itself the extent to which the costs of providing flood control works are to be recovered from project beneficiaries.

Local flood control districts, other public districts, and municipalities could probably serve as repayment mechanisms for State flood control projects. It is unlikely, however, that the State could adopt a single formula for local flood control contributions that would be fair and reasonable in all cases. In some cases it may be more practicable to require a contribution than in other cases, and, certainly, a "fair" contribution might vary widely depending on individual circumstances. Thus, for example, a requirement that project beneficiaries repay the costs of land acquisition might, because of the wide variation in those costs in relation to total costs, be reasonable for some projects and unreasonable for others. Similarly, a requirement that project beneficiaries repay a certain percentage of total cost might be well within the repayment capacities of some local agencies and well beyond the repayment capacities of others. Moreover, any such arbitrary cost-sharing formula would prevent the State from obtaining full reimbursement in those cases where local repayment capacity was wholly adequate.

Perhaps the only general requirement that the State could logically adopt would be that the local beneficiary groups, as a minimum, contribute to the costs allocated to the flood control purpose to an appropriate extent in view of their particular benefits, circumstances, and repayment capacities. If, as a practical matter, however, the local beneficiaries of a particular flood control facility are unwilling to repay the State fully for providing their benefits, it would seem necessary that the State in that case decide whether to abandon the flood control features of that project or to ask the general taxpayers to bear all or part of the costs. At the very least, sound policy requires that the State assume (as the federal government tends more and more to assume) that if project beneficiaries are unwilling to contribute to repaying the costs of the flood control purposes, flood control is, at best, a marginal purpose.

Other Project Services

Much of what has been said in conjunction with the reimbursability of flood control may also be said with respect to other project purposes that provide a service rather than a product (and for which the federal government in its projects does not normally seek repayment). If only the clearly identifiable direct benefits are taken into account in formulating a project and in allocating its costs, there is no obvious reason why the direct beneficiaries should not be asked to repay in full the costs of providing the benefits they receive. As in the case of flood control, local repayment districts might serve as the principal cost recovery mechanisms for such project purposes as salinity and water pollution control, although additional study would be needed to disclose

whether it is practical to create repayment districts or other agencies for those purposes or to attempt to collect from the beneficiaries in some alternative manner.

In the case of recreation, it may be impractical to separate the taxpayers of the State who use the recreational facilities from the taxpayers who do not, and it may be sensible to ask the taxpayers of the State generally to pay for the costs which might be allocated to recreation. At the same time, it would seem possible for the State to effect recovery of a substantial portion of those costs. While fees charged to recreationists for the use of State-owned facilities must in the public interest be nominal, it would seem possible to realize substantial contributions from the recreation industry itself by assessing charges to local recreation districts established for that purpose. Under the theory that tax monies should not be used to pay for developments which result in unearned profit to private individuals, it would also seem possible for the State to lease, rather than to sell, land which it may acquire for purposes of project construction and which is later used by private recreational enterprises (e.g., lodges, boathouses, piers, etc.). In this event, State leases might provide for charges which would allow these private enterprises to realize reasonable profits but which would tend to reserve to the State the monopoly gain or economic rent. Indeed, the State might consider purchasing for this purpose additional lands in the project area, since the leasing of land may be the best means of recovering the costs of recreational developments.

When projects incorporate special features for the enhancement of commercial fisheries, it would seem appropriate that the State seek reimbursement from the groups benefited. Where features are intended to enhance fish and game habitats for recreational purposes or are otherwise constructed for the protection of fish and game, some reimbursement might be effected through licensing and other sports fees.

Hydroelectric Power Generation

Investigation in connection with this study indicates that the State is not likely to encounter any difficulty in selling all the hydroelectric power it may generate in implementing the California Water Plan, and that it may do so at a price equal to the cost of generating power by the next most expensive alternative means (i.e., the cost of a steam-generating plant).

Thus, the repayment problems in connection with power are different from the repayment problems of the other project purposes. The question is not one of determining whether (or in what manner) allocated costs should or could be recovered from the beneficiaries. Rather, the primary question is one of determining the price at which the power ought to be sold. Should the State's hydroelectric power be sold at a price which just covers the costs allocated to power, or at a somewhat higher price, or at the full market price (i.e., the highest price which could be obtained by selling the power in the open market)?

The Question of Surplus Revenues. As was indicated in Section VII, there are techniques of cost allocation which, if used, could cause virtually all of the joint costs of a project to be allocated to power. For example, if the joint costs were allocated in proportion to anticipated net revenues rather than to anticipated benefits, such a cost allocation would tend to be achieved. Thus, even if the power generated by the State is sold at the highest possible price, the question of whether the State receives surplus revenues from the sale of power depends to some extent upon the method by which the joint costs of the project are allocated.

At the same time, it is reasonable to suppose that the costs of producing hydroelectric power will be less in the case of a multipurpose project than in the case of a single-purpose project. Thus, if the power generated by a single-purpose hydroelectric project were competitive in price with steam-generated power, the power generated at the same site by a multipurpose project could be expected to produce surplus revenues if it were sold at the market price. 1/

The Sale of Power at the Market Price. Assuming that over-all project costs are allocated in such a way that the costs allocated to power are less than the costs of generating power by an alternative means, the question arises as to whether the State should sell its power at a price in excess of that necessary to cover the allocated costs. 2/ As is well known, the issue of low-cost versus high-cost power has been, and continues to be, a source of public controversy in various sections of the United States, and there does not appear to be any satisfactory categorical answer to the question. Nevertheless, the apparent purpose of the State in generating and selling power is to obtain additional revenues to be used in furthering the California Water Plan. For this reason, and for the reason that the issue of low-cost versus high-cost power is not now and historically has not been a source of substantial controversy in the State of California, there would seem to be no clear-cut reason why the State should sell its power at less than the market (highest possible) price. While there is something to be said for the proposition that tax monies should not be used for private gain, this consideration would not appear relevant so long as the price paid

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1/ Technically, it is the cost of falling water in a multipurpose project which is less than in the case of a single-purpose project. The true cost of actually generating power can hardly be different depending upon whether the project is multipurpose or single purpose, or upon whether the generating plant is owned and operated by government or by private enterprise.

2/ In a Bureau of Reclamation project, power prices are established so as to recover the costs allocated to the power purpose plus a share of the costs allocated to the irrigation water supply purpose. Even so, the resulting price is generally well below the full market value of the power.

for power by a private buyer is equal to what it would cost that buyer to generate his own power in an alternative way.

The Disposition of Surplus Power Revenues. If power is sold to the highest bidder, and if the costs of the project are allocated in such a way that power costs appear to be less than power revenues, the question will arise as to how these surplus revenues should be used. In this regard, there would seem to be three general alternatives: (1) the surplus revenues could be applied as offsets to the costs of other projects or other project purposes, (2) they could be returned directly to the general fund, thus making it possible for the taxes paid by the general taxpayers of the State to be less than otherwise, or (3) they could be set aside in a special water development fund to assist in financing (but not repaying) subsequent projects.

If the State should follow federal practices, surplus power revenues would be applied to the repayment of other project purposes (i.e., specifically, the irrigation water supply purpose). But this has a number of ramifications. Revenues generated by project facilities belong in fact to the general taxpayer, and a subsidy is involved if they are used to repay the costs legitimately assigned to project purposes other than power. On the other hand, if it is assumed that the power really ought to be sold at a price just covering the costs allocated to the power purpose, it would follow that the surplus power revenues could be viewed as an overpayment by power users, and the application of these surplus revenues against the costs allocated to other project purposes could be regarded as a subsidy provided by the power users rather than by the general taxpayers. This situation would seem to have special significance in those instances in which the power users were located in one economic region and the subsidized beneficiaries were located in another economic region (as might be the case for the Feather River Project).

Because various projects may require substantial power inputs for water pumping, a common recommendation is that surplus power revenues be specifically applied against these pumping costs. If, however, State projects are to be genuinely multipurpose in nature, and if subsidies are to be avoided, the full costs of electric power for water pumping ought to be chargeable to the water supply purposes of the project, whether or not the State coincidentally generates power as another purpose of the same project. Even if the State used its own power in its own water pumping system, the imputed cost of the power used ought to be charged to the water supply purposes of the project if a subsidy is to be avoided. Moreover, some projects of the California Water Plan may generate substantial quantities of hydroelectric power, while others may not, and it would not seem reasonable by means of power revenues to subsidize the beneficiaries of one project and not those of another project. The principal point to be made, however, is that any such system of subsidization would tend to prevent the most economic allocation of the State's water resources. Those water supply

projects having the greatest hydroelectric power potential would be made to appear more economically desirable than they actually are, possibly preventing the construction of alternative projects in which the water resources could have been put to higher and better use.

For these reasons, therefore, it would seem preferable that surplus power revenues not be applied against the costs of other projects or project purposes. Because the State's objective in generating power is to obtain revenue for water resource development purposes, however, it would seem logical that these surplus revenues be set aside in a special water development fund to be used in financing (but not repaying) future water development projects. The monies in such a fund would belong to the general taxpayer, would be repaid by the beneficiaries of water development projects, and would eventually revert to the general fund of the State when all feasible projects have been built. This concept implies a loan of funds from the general taxpayer to the special project beneficiaries, but not the subsidizing of those beneficiaries.

<u>The Question of Preference</u>. Section 5 of the Reclamation Act of 1906 states in part:

> . . . whenever a development of power is necessary for the irrigation of lands under any project undertaken by the said Reclamation Act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding 10 years, <u>giving preference to municipal purposes</u>, any surplus power or power privilege. . . [underscoring supplied].

Since 1906, there have been numerous revisions of federal statements regarding this preference clause. Furthermore, it has frequently been interpreted to imply that public agencies are entitled not only to a preferential right to purchase power but also to a preferential price. In many cases federal agencies have sold power to local public agencies at prices below what it would cost private enterprise to produce power by an alternative means, while refusing to sell power to private customers at the same low price even when there were no competing public buyers. In other cases, federal agencies have constructed costly transmission systems in order to serve "preference customers," even though such systems duplicated and paralleled existing systems of private utilities. 1/

1/ In the Central Valley Project, most preference customers are served through the transmission system of the Pacific Gas & Electric Company on the basis of a "wheeling" agreement existing between the government and that company.

Federal preference practices have been criticized by a number of study groups,[1] and the State of California has expressed its views on the subject as follows:

> Sale of power, water, or other commodities from a project, should be at their respective market values, and in no case at prices less than cost. Preference as to the purchase of power, water, or other commodities, should be given public agencies and interests, but not at preferential prices.[2]

A similar policy is expressed in paragraph 11626 of the State Water Code. This paragraph states in part:

> In entering into and awarding contracts, _in case of equal or equivalent offers_, . . . the authority shall grant preference to State agencies or other organizations not organized or doing business for profit but primarily for the purpose of supplying water or electric power to their own citizens or members [underscoring supplied].

If the State intends to sell project power at the highest price obtainable, the question of preference may be relevant only in the event that the State is faced with the choice of selling at the full market price either to private enterprise or to a public agency. This problem would not be likely to arise if each block of power is sold to the highest bidder regardless of whether the bidder is a public or a private enterprise. It is true, too, that sale to the highest bidder does not necessarily imply that all project power would be sold to private enterprise. Because public enterprise is not obliged to pay taxes or to achieve a rate of return on investment comparable to private profit, public agencies may be expected to offer competitive bids, particularly in those instances in which they lack the capability or interest to construct and operate generating plants to meet their own needs. Thus, conceivably, the occasion may arise when both public and private agencies offer to pay equivalent prices for project power, and the retention of a purchase preference policy in the case of equal offers may be desirable.

1/ A Hoover Commission task force has commented, for example, that ". . . there is no sound economic justification for the preference policy. Its continuance causes further unnecessary expenditures in contravention of the statutory objectives."--_Task Force Report on Water Resources and Power_, Vol. II, 1955, p. 301 (Ref. 210). On the same subject, the Water Policy Panel of the Engineers Joint Council has stated that ". . . federal power should be sold without priorities or preferences in any respect to any purchasers or consumers or class thereof."—Engineers Joint Council, _National Water Policy_, 1950, Appendix 5, p. 10 (Ref. 17).

2/ _Views of the State of California on Water Resources and Power Functions of Federal Departments and Agencies_, 1954 (Ref. 128).

Water Supply Purposes

The repayment of costs allocated to the water supply purposes of projects is, of course, the core of the repayment problem faced by the State in implementing the California Water Plan. The remainder of this section is therefore devoted to an examination of these repayment aspects. It is presumed that the State will act as a wholesaler of project water, serving local agencies rather than individual water users and effecting repayment through those agencies. These marketing considerations will be discussed in Section IX.

It is important to reiterate that there would seem to be essential differences between the objectives of the State's water program and of the water program of the federal government. The federal government does not undertake to supply water for municipal and industrial use as such, and the provision by the federal government of irrigation water is incidental to the objectives of land reclamation and/or flood control. Thus, federal precedents may not be suitable for adoption by the State.

The Distinction Between Water for Irrigation Use and for Municipal and Industrial Use. The federal government has regarded the provision of irrigation water as a project purpose separate and apart from the provision of water for municipal and industrial use. Benefits have been measured separately for these two project purposes, costs have been allocated separately, and repayment schedules have been established separately. The subsidization of irrigation water has tended further to segregate the market for project water into these two distinct parts, and this distinction has carried over into the private economy as well. Many private water companies, for example, offer lower rates and charges for irrigation water than for municipal and industrial water, either directly in their schedules or through price differentials based on quantities of water delivered. 1/ If these precedents are followed, irrigation water and municipal and industrial water to be supplied by State projects may also be regarded as serving different markets.

1/ In technical terms, when a monopolist is faced with two or more separated markets, he will maximize his total revenue from a given volume of sales when the marginal revenue in each of the separated markets is the same. But if the elasticity of demand is not the same in the separated markets, the marginal revenues will be equalized only at different prices. Since irrigators are unlikely to resell their water to urban water users and since the demand of urban water users is less elastic than the demand of irrigators, it is sound business practice for water sellers to charge a higher price for municipal and industrial than for irrigation water.

Certainly, if benefits are measured separately and costs are allocated separately using benefit values as determinants, different repayment requirements will result. Since, moreover, the benefit value per unit of municipal and industrial water is likely to be greater than that of irrigation water, the price per unit of municipal and industrial water is likely to be greater than that of irrigation water. In any repayment schedule based on allocated costs, then, the repayment responsibility of irrigation water users will be less on a per-unit basis than will the repayment responsibility of municipal and industrial water users. This difference is attributable to the causes mentioned rather than to any State policy of deliberate subsidization of irrigation water users as such.

Also, if repayment requirements reflect the relative costs of transporting water to the various beneficiary groups, this differential in repayment responsibilities will likely be accentuated. Most of the water that will be made available for agricultural purposes under the provisions of the California Water Plan will be transported a shorter distance than most of the water that will be made available for municipal and industrial use.

Irrigation Water. In federal practice, interest is waived on costs allocated to the irrigation water supply purpose. This waiver amounts to a hidden subsidy which, over the lifetime of a typical project, reduces by about one-half the irrigation water user's repayment responsibility.1/ Costs allocated to irrigation are further limited to an amount separately determined to be within the user's "ability to pay." Remaining costs are then reassigned for repayment from surplus power revenues, from revenues remaining from the sale of municipal and industrial water after the costs of that purpose have been amortized, and, in certain instances, from a portion of power revenues equivalent to the interest repayment on costs allocated to the power purpose.

The "ability to pay" determination is in effect negotiated by the federal government with the beneficiary groups. "Ability to pay" is in reality an expression of the amount that the beneficiary believes he ought to be required to pay in view of established policies of subsidization and cost sharing. Usually, it is an amount that he is willing to pay in view of the amounts that other users served by other projects are paying. Thus, the repayment determination is an arbitrary one, largely unrelated to allocated costs.

The adoption of these practices by the State would hardly seem appropriate or reasonable in view of the multipurpose objectives of the California Water Plan. The interest of the State in supplying irrigation water would seem to be no different from that in supplying municipal and

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1/ This practice has been criticized severely by most study groups. For representative views on the subject, see Circular No. A-47, 1952 (Ref. 179).

industrial water. Moreover, if a project has been formulated properly on the basis of estimates of economic demand, beneficiaries can be expected to have the ability to repay all costs (including interest) allocated to the irrigation water supply purpose. 1/

Because of a difference in basic objectives, it is likely that any repayment policy that the State might adopt with respect to irrigation water will result in repayment terms less attractive to irrigators than those of the Bureau of Reclamation. This fact will have an important bearing on the demand for irrigation water to be supplied by State projects. In those agricultural areas of the State in which construction of a federal irrigation project is an alternative to receiving water service from the State, the quantities of State irrigation water demanded will remain unknown until (1) irrigators are able to compare State and federal terms, and (2) the exact nature and extent of future federal construction is resolved. Until these determinations are made, no realistic basis exists for planning State projects intended to supply irrigation water to those agricultural areas.

Municipal and Industrial Water. The objectives of the State suggest that the repayment policy for municipal and industrial water be the same as for irrigation water (i. e., full repayment of allocated costs by the beneficiaries). But, again, as in the case of irrigation water, care must be taken to consider the effect of competitive sources of supply on the demand for State water service. Many municipalities and local agencies have assumed a responsibility to supply water needs within given service areas. In cases in which major supply works have been constructed by these local interests, amortization of the costs of those works depends upon continued water sales throughout those service areas. Thus, even though State terms might be more attractive to beneficiary groups located in these service areas, it is unlikely that the State could or would upset these local arrangements by offering a competitive source of water service. And, until State terms for water service are known, the quantities of municipal and industrial water that the State might be able to sell cannot readily be determined.

Alternative Approaches to Water Repayment

The discussion of project formulation, cost allocation, and repayment planning thus far in the report has dealt with single projects and the separate purposes of single projects. Project-by-project analysis and justification is necessary if the development of the California Water

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1/ In a proper demand analysis, "ability to pay" is an automatic and implicit consideration. Demand is an expression of the quantity of a commodity that can be sold at a given price. Thus, a separate determination of "ability to pay" after a project is constructed is meaningless.

Plan is to proceed on sound economic grounds. Nevertheless, it is not essential that the actual repayment of costs allocated to the water supply purposes of projects be effected on a project-by-project basis, even though the financial feasibility of each project is tested separately. From the point of view of the State, it is necessary only that the total repayments actually received from the water supply purposes of all projects be sufficient to repay the total of the costs allocated to water supply purposes in all of the projects.

Thus, conceivably, all the capital costs (and the corresponding rights to use water) of all projects might be averaged together and apportioned for repayment among <u>all</u> users regardless of their location, the use to which they put the water, or the point in time when their demand for water became significant. Accordingly, as projects 2 and 3 and so on of the California Water Plan are constructed, costs would be reaveraged throughout the system as a whole and the beneficiaries of project 1 would become obligated to help pay the capital costs of projects 2 and 3 and so on. Similarly, the beneficiaries of the later projects would become obligated to help pay the unamortized capital costs of earlier projects.

This procedure would have the effect of making the entire State a single water utility district roughly comparable, for example, to the Metropolitan Water District of Southern California,[1] and State water charges would tend to be the same throughout the State. This would amount, in other words, to a "postage stamp" rate approach to water pricing.

A variation of this approach has also been suggested in current public discussions of the California Water Plan. This capital cost-sharing arrangement has become known as the "f. o. b. pool" pricing system because it considers that, at least as currently envisioned, most major projects of the California Water Plan either would deliver water into a physical pool located at the San Joaquin-Sacramento River Delta or would transport water from that pool. According to this variation, all of the costs of delivering water to the Delta pool would be averaged and apportioned for repayment among all of the users of water actually taken from the pool, regardless of the original source of the water. In effect, an f. o. b. price would be established at the pool. The additional costs of transporting water from the pool, however, would be borne by the beneficiaries of each individual project. The f. o. b. price at the pool would be periodically revised either upward or downward as new capital costs are incurred to replenish the pool and as more "user" projects join the system to share in the costs. In its pure form, the "f. o. b. pool" water pricing system would apply only to water actually

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1/ Except that all of the Metropolitan Water District water users are served from a single surface water source and can legitimately be asked, therefore, to share the capital costs of conveying the water from that source.

being delivered to and taken from the Delta. Water delivered to water users without actually going through the Delta would presumably be priced separately on a project-by-project basis.

Another variation of this system would be the adoption of a cost apportionment system which presumed the existence of a hypothetical f. o. b. pricing point at the Delta whether or not all projects were in fact served from the Delta. Thus, the mythical costs of getting water to the Delta would be borne by all the users of State water, and the mythical costs of delivering water from the Delta would be borne by water users in proportion to their distance from the Delta.

Repayment on a project-by-project basis, on the other hand, assumes that each project has been built for a particular group of beneficiaries, and that, while repayment obligations and rights to purchase water might be reallocated among these people, they are collectively entitled to purchase all of the water made available by, and are commensurately responsible for, the repayment of all of the water costs of their particular project.

Strengths and Weaknesses of the Alternative Approaches to Water Repayment

The "postage stamp" and "f. o. b. pool" approaches to water pricing attempt to recognize that there are variations in the rates at which demand for water will increase in various areas of the State and that the development of new water supplies will become increasingly costly. These methods are, in other words, attempts to avoid the traditional pattern that those who happen to be served by the first projects will pay less for their benefits than those served by later projects. The methods tend to view the California Water Plan as a comprehensive system of interrelated water projects in which costs should be borne somewhat equally by all beneficiaries, regardless of the point in time that their particular projects are constructed

For these reasons, the methods might result in a more economic allocation of water than if water costs were repaid on a project-by-project basis. There would be no assurance under these systems, for example, that the costs assigned to a particular group of beneficiaries would not eventually exceed the value of that group's benefits. Thus, these systems would tend to have the effect of forcing a redistribution of the available water as the earlier water users for whom water had a relatively low use value become unable or unwilling to pay the rising costs of the over-all water development program. But such a redistribution would violate the historical approach to water development in the State of California, an approach which has been based on the legal maxim that the people originally responsible for appropriating and putting to beneficial use a particular supply of water are forever after entitled to the use of that water. Probably, so long as there is a rigid system of water rights allocation, these methods would not be capable of practical application.

For various reasons, the purchase and sale of water rights is relatively uncommon, and water may continue to be used by people who would not obtain the water, at least not so much water, if they had to bid it away from alternative users--if, that is to say, they had to pay the current opportunity cost of water in order to use it themselves.[1] In spite of its attractiveness from an economic viewpoint, however, any flexible system of water right allocations could not provide the security or rigidity needed if water users are to be induced to repay the substantial sums of money invested in the construction of the plant and equipment needed for maximum water development.[2]

Even though spreading the capital costs of a utility district among all the subscribers of the utility is common practice, a utility pricing system is usually based on the fact that the physical facilities are operationally integrated and that service areas are more or less contiguous. It is questionable that a comparable situation exists with respect to water projects of the California Water Plan. Many projects may be wholly unrelated, and they may be so separated in both physical distance and time of construction that a utility pricing system would be illogical.

A particular difficulty with a state-wide utility or "postage stamp" rate approach is that there would be no necessary relationship between the price a particular water repayment agency would be charged for water and the actual costs of delivering the water to that agency. Thus, at any given time, the people close to the basic source of water would be subsidizing the people farther away. Similarly, under the "f. o. b. pool" concept, the beneficiaries of earlier projects, by sharing the costs of subsequent projects, would in effect subsidize the beneficiaries of the later projects.

As a practical matter, moreover, it may well be that few, if any, water agencies would be willing to sign, in advance of project construction, contracts which do not guarantee firm water rights and do not provide for the assessment of water repayments on the basis of a known and simple formula. And, unless some means exists by which projects could be financed and authorized automatically, it is unlikely that the beneficiaries of the earlier projects would cast their votes in favor of

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1/ Thus, for example, water may be used in the Imperial Valley where it is worth no more than, say, $10 an acre-foot instead of in San Diego where it is worth, say, $75 an acre-foot. As a result, San Diego may have to obtain from Northern California water which has not yet been legally appropriated but which will cost San Diego considerably more than $10 an acre-foot.

2/ For further discussion, see Ciriacy-Wantrup, S. V., "Some Economic Issues in Water Rights," 1955, p. 880 (Ref. 275). See also "The Movement for New Water Rights Laws in the Tennessee Valley States," 1955, p. 801 (Ref. 339).

constructing additional projects from which they would not benefit but whose repayment costs they would be required to share.

For these various reasons, it would seem that recovery of water costs on a project-by-project basis is the most straightforward and appropriate approach. Probably, at least, it is the most practical approach to the problem.

Geographical Apportionment of Repayment Responsibilities

Even though the State might decide upon the recovery of costs on a project-by-project basis, the problem arises as to whether there should be a uniform "postage stamp" charge for water throughout the project service area as a whole, or whether charges should vary depending upon the geographical location of the different beneficiary groups (i.e., contracting agencies). The service area of a typical federal project is relatively small, and uniform charges are normally established. But the major projects envisioned in the California Water Plan are extremely broad in their geographical scope. This fact suggests the use of charges that reflect the particular costs of serving the various areas. If, for example, the costs of serving one area are appreciably greater than the costs of serving another area, an averaging of costs for repayment purposes could readily result in the assignment of costs to a particular contracting agency in excess of the value of that agency's benefits (i.e., in excess of its true ability to repay). Moreover, investigation in connection with this study indicates that potential beneficiary groups are willing to accept State charges that reflect obvious cost differentials based on the geographical location of the various project service areas.

As discussed in Section VII, consistency of method and soundness of procedure would seem to require that if costs are allocated to the various project purposes by the separable costs-remaining benefits method, then costs ought to be reapportioned geographically by means of the same method (based on the same principles). In other words, the State would seek to recover from each contracting agency:

1. The "separable costs" of serving that agency (i.e., the difference in the total cost of the project purpose with and without service to that agency), plus

2. A share of the "joint costs," if any, in proportion to that agency's "remaining benefits."

In the case of a single agency receiving water for both irrigation use and municipal and industrial use, the State would seek to recover two separate repayment amounts, each amount computed as indicated above.

Cost Recovery through Water Sales at a Single Price

Once the State has determined each agency's repayment requirement, the manner in which repayment is to be effected must be determined.

For the reasons previously discussed in this report, it is assumed that the State has two basic objectives in establishing water repayment schedules: (1) to recover from each contracting agency, over the economic lifetime of the project, all of the costs allocated to those agencies for repayment purposes; and, insofar as is consistent with this first objective, (2) to maximize the net benefits of water both in the long and the short run. 1/

The attainment of these objectives is complicated, however, by the fact that provision of additional water supply facilities cannot be delayed until there is sufficient demand to permit the "profitable" sale of all the water which can be delivered. The availability of water supply facilities must precede, rather than follow, the demand for water, for the demand is unlikely ever to develop if the water is not already available. There is, in short, no way for the State to avoid a period of time during which its water facilities will have excess capacity in the sense that they will be capable of delivering more water than can be sold at prices which will cover costs. Furthermore, there may be a considerable difference between the water repayment arrangement which is correct when the facilities are being only partially used and that which is correct when they are being fully used.

Ideally, there is a single per-acre-foot price at which revenue generated as a result of the sale of water over the entire economic lifetime of the project will exactly cover the costs which will accrue during the economic lifetime of the project. The use of such a single price, however, has certain disadvantages. During the years immediately following the completion of the project, and while demand is developing, not enough revenue would likely be generated through the sale of water at this price to cover the annual fixed costs. Beyond this, demand may

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1/ As discussed in Section III, there may be other over-all objectives of the California Water Plan: for example, to supplement existing supplies of water and to supplement the construction programs of existing water development agencies including the federal government. In other words, the State may seek through its policies to induce the optimum utilization and development of its water resources. Presumably, however, objectives such as these are better accomplished in the initial formulation of a project rather than through a repayment policy. Once the State has sponsored the construction of physical facilities, it is presumed that the objectives will be those indicated in the text above.

develop less rapidly than predicted (or it may never develop at all), with the result that the total costs of the project will never be recovered through the sale of water alone.

One approach to this latter problem—an approach generally followed by the Bureau of Reclamation (as will be explained in more detail in Section IX)--is to specify in advance of project construction that water users must agree to purchase certain minimum quantities of water regardless of the quantity of water actually demanded at the established price. By prearrangement, moreover, the minimum quantities could be increased periodically so as to parallel, at least roughly, estimates of increasing demand. In effect, the water users would be committing themselves, in advance, to repay certain minimum costs regardless of the quantity of water actually delivered. These minimums would be so established as to ensure full cost recovery over the lifetime of the project.

A second possible price is one which would just cover operation and maintenance costs until full capacity operations are reached. It is a principal of welfare economics that it is wasteful for government to attempt to recover the fixed costs of a government enterprise if to do so would involve charging a price which would reduce the quantity sold below what could actually be produced. Since the output is available whether or not fixed costs are recovered, this theory suggests that citizens ought to realize the benefits and government ought to attempt to recover only its "marginal" or "out-of-pocket" costs which vary with output. In the case of a State water project, this would mean that the State would attempt to recover only its operation and maintenance costs during the period of demand build-up if charging part of the fixed costs would decrease the quantity of water used.

But this approach would involve bookkeeping losses at least until full capacity operations are reached. At least temporarily it might also cause the water provided by the State to displace existing water sources which the State intended to supplement rather than supplant. Unless the general taxpayer of the State is willing to subsidize water users permanently, moreover, this approach would require the State to adjust its price upward, perhaps drastically and with unsettling economic consequences, after full capacity operations have been attained.

Another approach would be to establish at the outset a single price designed to cover costs under the assumption of full capacity operations throughout the lifetime of the project. This policy would have the disadvantage, however, of causing the water program to operate at a loss much of the time--particularly in the years immediately after project construction has been completed. Alternatively, the State might vary the price of water with the objective of obtaining enough revenue in any given year to cover the costs accruing during that year. However, the total quantity of water which the State can sell will vary depending, in part, upon the price, and therefore it may be impossible for the State to recover solely through the sale of water all of the costs which accrue during any given time period.

Cost Recovery through a Fixed and a Variable Charge

It may be that the approach to water repayment which is best suited to the water development projects sponsored by the State of California would be a combination of the minimum charge approach of the Bureau of Reclamation and the marginal cost pricing approach suggested by studies of welfare economics. Prior to the construction of water facilities, as will be explained in more detail in Section IX, the State could enter into agreements with local water agencies under the terms of which the State would undertake to provide certain maximum amounts of water, and the agencies would undertake to repay the State annually by means of a two-part payment. The first part would be an annual fixed (or "capacity") charge, payable by the agency even if it received no water at all. The second part would be a variable charge which would depend upon the quantity of water actually taken by the agency.

The fixed or capacity charge would cover all of the fixed costs allocated annually to the contracting agency. It could be thought of as the purchase by the agency of a right to obtain a certain amount of water, or as the payment of the agency's share of the costs of providing the water facilities it will use. It would be similar to the minimum charge approach of the Bureau of Reclamation in that, unless the contracts were broken, the State could recover its capital costs plus a reasonable return on investment regardless of fluctuations in the demand for water. At the same time, it would differ from the Bureau's approach in that this "minimum" payment would not pay for the delivery of any water.

The charge would be similar in concept to the "demand charges" that electric utilities frequently assess their customers for making capacity (rather than electric power per se) available. The charge would be fixed in the sense that it would not depend upon the quantity of water actually used by the agency in any given year, although it might vary from year to year because (1) total capital costs are repaid in amounts which change each year during the economic lifetime of the project, or because (2) the share of the total annual fixed costs allotted to any given agency might change in accordance with occasional revisions in water allocations.

The second part of the water charge would be a variable amount designed to cover the operation and maintenance costs of providing the water actually taken by the agency. It would amount to a "price" equalling "marginal" costs, the lowest price consistent with the objective of covering those costs which could be avoided by reductions in project output. Such a price would encourage the maximum economic use of the facilities and, hence, would tend to stimulate the maximum possible economic increase in real income or benefits. Furthermore, it would not increase substantially or at all after full capacity water use has been reached.

It should be the prerogative of each contracting agency to obtain the funds needed to repay its two-part charge in any manner it chooses. Thus, a public water district, for example, might collect all of the required funds by reselling project water to the water users of the district; it might collect all of the required funds by general taxation within the district; or it might (as it probably would) resort to some combination of these two approaches. Ideally, the indirect beneficiaries within a district would pay for their benefits through taxes, while the direct beneficiaries would pay for their benefits through both taxes and water prices. But the method of achieving this ideal in practice ought to be left to the local water repayment districts rather than prescribed by the State.

It is a corollary of the two-part charge approach to water repayment that the various repayment agencies would not acquire the right to purchase water at some future time unless they signed advance contracts specifying their willingness to pay a fixed or capacity charge. But this might raise a number of problems. As a practical matter, for example, it would be impossible for the State to predict before a project was constructed precisely how the water to be supplied by the project could be most economically allocated among alternative users and uses 50, or even 20, years hence. It is, of course, obvious that rough predictions must be made for purposes of engineering design and for benefit-cost calculations by area as well as by project purpose. Nevertheless, as will be discussed in detail in Section IX, it may be desirable that the original geographic apportionments of fixed costs and of rights to purchase water be subject to some modification as circumstances change.

Beyond this, some agencies might be financially unable at the outset of the repayment period to pay a capacity charge even though the acquisition of a right to purchase water at some future time is justified on the basis of predictions of their future water demand. There may be, in other words, substantial variations between agencies in terms of the rates at which their demand for water will increase. For this reason, in special cases, it might be necessary for the State to forego the collection of the capacity charge for some prescribed development period. If this is done, however, the transactions ought to be regarded as a loan from the State to the agency, the assumption being that, each year after the period of development, the agency would be obligated to repay the State the normal annual capacity charge plus some portion of the capacity charge which accrued during the development period plus interest on this accrued but unpaid capacity charge. While the State would probably not wish to deprive an agency having a potential demand for water of the right to purchase water when the demand developed in fact, it could not afford to incur the capital costs of water development without reasonable assurance that these costs could be recovered from beneficiaries over the economic lifetime of the project.

Section IX

MARKETING OF PROJECT WATER

There are over 2,800 public and private water agencies serving local areas in California. Within this organizational complex, the agencies vary widely in size, financial capacity, legal authority, and scope of interest. In marketing project water, the State will act as wholesale supplier to many of these agencies. The agencies, in turn, will supply project water to their customers or members on a resale basis.

The adequacy of the legal and financial structures of the various water agencies will affect local demand for project water and will have an important influence on the financial feasibility of State projects. This section of the report therefore reviews the characteristics of existing forms of water agencies, discusses the adequacy of certain of these agencies as distribution and repayment mechanisms for State projects, and considers the general manner in which the State might contract with these agencies.

General Characteristics of Existing Agencies

The private water agencies are of two types: public utilities companies (i.e., commercial companies) and mutual water companies. The public agencies are also of two types: municipal waterworks and public water districts. The public utilities companies are private enterprises operating under public regulation.[1/] The mutual water companies are nonprofit, cooperative enterprises under private ownership formed for the purpose of serving their own members or stockholders. Municipal waterworks, of course, are municipally owned and operated to supply and distribute water mainly within the boundaries of their respective municipalities. The public districts are organizations formed through either a petition and voting procedure or special legislative action to undertake water development or similar conservation measures. The public district differs from all other water agencies in that it itself has powers of taxation, assessment, and eminent domain.

Some 51 percent of all of the State's water agencies are mutual companies, 25 percent are public districts, 17 percent are public utilities companies, and the remaining 7 percent are municipal entities. The agencies range from small districts or companies concerned

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1/ The State Public Utilities Commission is the regulatory body. The commission has jurisdiction over more than 1,500 private utilities and transportation companies in California. It does not, however, exercise regulatory powers over municipally owned utilities, mutual water companies, or public districts.

entirely or principally with serving members of a single family or a corporation to the vast organization of the Metropolitan Water District of Southern California which serves an area of more than 3,000 square miles containing a population in excess of 6 million.

In certain parts of the State, such as in Southern California and in the San Francisco Bay Area, a few relatively large organizations serve regional needs. In contrast, other areas are served by numerous small agencies. The Central Valley area, for example, is served by some 1,000 agencies, most of which are independent and separate organizations.

The Public District

Although there is apparently no legal reason why public utilities companies or mutual water companies could not contract directly with the State for project water, it is not likely that they would do so. The distribution systems of these private companies are characteristically limited in capacity and their operational areas are usually well defined. It is unlikely, therefore, that these companies would or could undertake major expansions of their systems to participate directly in the State's program in any appreciable degree. These companies can therefore be expected to procure project water, if at all, on a resale basis from public districts or from municipalities.

Municipalities requiring project water would either deal directly with the State or would procure their supplies from public districts directly served by State projects. In any event, direct contracting between the State and municipalities would seem to pose no particular difficulties.

Of the four types of agencies, it will be the public district with which the State will primarily be concerned in its marketing program. These districts serve approximately 74 percent of the State's total irrigated acreage[1/] and, directly or indirectly, many of its domestic water connections.[2/] The existing pattern of public districts has evolved from some 30 general acts and some 40 special acts.[3/]

1/ About 90 percent of the water presently used in California is used in irrigation.

2/ Though the public districts directly serve only some 15 percent of the State's domestic water connections, they serve an additional (unknown) number indirectly through their wholesale operations to their memberships.

3/ See Analysis of California District Laws, 1954, 1955 (Ref. 144); and General Comparison of California Water District Acts, 1955 (Ref. 109). Note: A chronological listing of these acts is also contained in Appendix A of this report.

These acts have enabled no fewer than 15 major organizational forms of public districts which have the power to acquire and sell water. These organizational forms, together with the approximate present number of districts in each, are as follows:1/

- Community service districts (40)
- County water agencies (2)
- County water authorities (2)
- County water districts (125)
- County waterworks districts (75)
- Flood control and water conservation districts (10)2/
- Irrigation districts (114)
- Metropolitan water districts (1)
- Municipal utility districts (7)
- Municipal water districts (28)
- Public utility districts (75)
- Reclamation districts (138)
- Water conservation districts (18)
- Water districts (67)
- Water storage districts (4)

Legal Purposes

The enabling acts of the various forms of public districts define their legal purposes in widely differing terms (see Appendix B for a general comparison of district purposes). For example, the Irrigation District Law permits irrigation districts to "furnish water for and put water to any beneficial use." The Metropolitan Water District Act permits the development, storage, and distribution of water for municipal and domestic purposes. Reclamation districts may supply water for irrigation use, while municipal water districts are concerned with a variety of water supply purposes for the "benefit of the district." County water districts may undertake drainage and reclamation measures as well as obtaining, storing, and distributing water for domestic and irrigation use. Municipal utility districts furnish a variety of general utility services in addition to supplying water.

Some districts develop their own water supplies, while others obtain supplies from federal projects or from other agencies or districts. Certain districts sell water directly to consumers, while

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1/ See Water Utilization and Requirements of California, Vol. 2, 1955 (Ref. 167). Note: Because of dissolvements, formations, and annexations, the number of districts changes continually.

2/ Certain flood control and water conservation districts are not specifically granted authority to acquire and sell water and are therefore excluded in the number of districts indicated.

others sell water on a wholesale basis to their member districts. A number of districts are intended to benefit all residents within their boundaries; others have been established to meet the needs of special groups.

In some instances, a district is a master planning and supply agency for a number of other districts. The Metropolitan Water District of Southern California, for example, presently serves 12 municipal water supply works, 9 municipal water districts, and a county water authority. Furthermore, a number of these districts are actually combinations of several districts in which the member districts continue to maintain their separate identities and functions.

Territory Served

Over the years there has been a trend both toward regional coalitions of districts and toward the development of small improvement districts which in some cases has resulted in a pyramiding of organizational structures. The California Districts Securities Commission has cited the example of one small water district that serves some 1,300 acres of land in San Diego County.[1] The district is a member agency of a municipal water district which, in turn, is a member agency of the county water district which, in turn, is a member of the county water authority which, in turn, is a member agency of the Metropolitan Water District of Southern California!

Thus, the territories that the various forms of districts may serve vary widely in both size and nature (see Appendix B). Metropolitan water districts may encompass various types of districts and agencies within two or more counties that are not necessarily contiguous. County water districts and municipal water districts may encompass the territory of two or more counties which are contiguous. It would appear from the wording of the general act that county water authorities could also serve territories in more than one county depending upon the specific boundaries of their member agencies. A special act establishing the Santa Clara-Alameda-San Benito County Water Authority permits that Authority jurisdiction over water agencies located within the three counties.

Some districts, such as flood control and water conservation districts and county water agencies, are limited to territory wholly within a particular county. The territories of irrigation districts, water districts, and water storage districts are limited to those lands that are irrigable from a common source. Territories of water conservation districts are defined in terms of the watersheds of

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1/ Stivers, T. P., "Financial Problems Concerning Irrigation and Water Districts," 1957 (Ref. 530).

unnavigable streams, and the operations of community services districts are confined to unincorporated territory.

The inclusion of an agency as a member of a larger district organization is generally voluntary on the part of that agency and does not impair the agency's legal existence.

Relative Financial Capacities

The taxation and assessment powers of the various forms of public districts vary considerably.[1/] Certain of the districts are authorized to levy a general tax on all property (both real and personal) within their boundaries, others may assess land values only, and still others may levy assessments only against lands actually benefiting directly from the water development programs or other conservation measures. Metropolitan water districts, municipal utility districts, and county water authorities, for example, are empowered to levy a general tax on all property. Water districts and irrigation districts are permitted only an annual ad valorem assessment on lands. And, organizations such as water storage districts may levy only special assessments against benefited lands.

In addition, almost all districts are limited in their total assessment or taxing powers, and these limitations (or "ceilings") vary by type of district and, often, from district to district. One district, for example, may be permitted an assessment of 5 cents per hundred dollars of assessed property value, while another may assess up to 15 cents per hundred dollars of value. Certain districts are permitted unlimited taxing power.

Variations in the total assessed valuation (i.e., the property tax base) from district to district are also significant. These variations are functions both of the size of the district and the nature of its land use. Thus, large districts with a high proportion of urban land use are able to rely substantially on their tax base as a source of income, whereas smaller districts with a preponderance of rural land use must in the long run rely primarily on revenues from water sales and from other services that they render. The Metropolitan Water District of Southern California, for example, presently derives some 65 percent of its income from its general tax base, whereas the average irrigation district obtains less than 25 percent of its income in that manner.

1/ The words "taxation" and "assessment" are not synonomous. In general, government imposes the cost of public services through general taxes, ad valorem assessments, and/or special assessments. General taxes apply uniformly to all individuals and are therefore not based on relative benefit; ad valorem assessments also apply uniformly but only to certain individuals; and special assessments apply only to certain individuals and are based on those individuals' special benefit.

Thus, the financial capacities of districts vary widely, depending upon their physical size, their taxation and assessment powers, and the size and nature of their tax base.

Weaknesses of Existing Public Districts As Project Repayment Mechanisms

In establishing a marketing and repayment mechanism for water to be supplied by its projects, the State would seem faced with a number of difficulties. First, the existence of numerous small and independent districts in areas such as the Central Valley will likely render contract administration complicated and cumbersome. Secondly, the financial structures and capacities of certain districts or certain types of districts may not offer a necessary stability or be otherwise adequate to permit their entering into long-term contracts without substantial risk of default--particularly if the State expects repayment of fixed costs regardless of the quantity of water sold. For example, an inadequate tax base may force some districts to repay a disproportionate share of their annual water charges from revenues received through the resale of water. In the event of an appreciable decline in water sales (occasioned, for example, by a "wet cycle"), the district's tax base might be insufficient to carry the added repayment burden.

Third, the limited repayment capacity of many districts may well preclude their full participation in the benefits of the California Water Plan. Some districts may not be able either to meet their contract obligations to the State or to provide the necessary auxiliary works to distribute project water locally. One result of this situation would be that demand for project water would be severely restricted; another result might be that the State would find it necessary on welfare grounds to undertake an extensive program of financial assistance to local districts.

Fourth, irrespective of their financial capacities, there is apparently some question that certain types of districts could legally contract with the State for water that is intended for certain uses or that those districts could accept an allocation of cost from the State incident to supplying water for those uses.

It appears, therefore, that many districts, either because of their particular organizational forms or because of their individual financial structures, may not be wholly adequate as contracting agencies to the State.

The Need for Adequate Public District Structures

The California Water Plan contemplates that many of the water projects envisioned will be constructed by local interests, either

with or without State aid. For projects that the State itself will construct, local agencies will contract with the State for the purchase of project water and will construct the auxiliary facilities necessary for the distribution of that water. Thus, the role of these agencies in implementing the California Water Plan is to be of sufficient importance to require that they have adequate powers to meet their responsibilities.

In functioning both as coordinator of the Plan and as a wholesale supplier of water, the State preferably should seek to deal with a few relatively large public district organizations rather than with a multitude of small organizations. Such an arrangement would greatly simplify the State's administrative and operational burden, would tend to remove the State from involvement in many matters of primarily local concern, and would place much greater emphasis on local responsibility and local determination. Simplification of procedures at the State level and a greater local autonomy would, in turn, be likely to result in a more efficient and effective water development program than would otherwise be possible.

Ideally, from the State's point of view, the various public districts with which it will contract should be somewhat regional in their scope and have authority, among other things, to:

1. Acquire, store, and distribute water for domestic, irrigation, industrial, municipal, and other beneficial uses.

2. Exercise general taxing power over all property within their boundaries.

3. Establish and collect water charges and taxes incident to the repayment of district obligations for State project water acquired on behalf of the districts' memberships.

In those areas of the State where districts (or coalitions of districts) of suitable regional scope do not now exist, the State might assume leadership in encouraging local initiative to take such action. In this regard, certain types of existing district forms, such as municipal utility districts, metropolitan water districts, and county water authorities, may generally be adequate for the State's purposes. On the other hand, certain modifications of these and other district forms may be desirable either to broaden their scope of authority or to strengthen their financial structures.

Preferably, each regional district should include within its boundaries sufficient urban or other high-value land to ensure an adequate and stable tax base. As indicated in Section V, the consideration of secondary benefits accruing to local areas from specific water development projects would seem to offer the means by which

a broadening of district tax bases could be justified. Urban communities located in predominantly agricultural areas, for example, benefit indirectly from the introduction of new sources of irrigation water. The increased economic activity that they realize should justify their participation in a district:

> . . . it has long been recognized that increase in property values of agricultural lands under irrigation development is at least matched and usually exceeded by the increase in nonagricultural suburban and urban areas. Indeed, it seems that from these latter areas actually arises much of the great pressure for expansion of irrigation. Entirely too frequently demand for an irrigation project stems from main street rather than from the farming area itself.
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> With rising cost of irrigation development it becomes more and more important that urban and suburban beneficiaries share in repayment cost. The benefits this group receives are fully equal to those received by the agricultural beneficiaries. Responsibilities for project repayment should be shared in the same manner.[1/]

This same concept is presently followed in many of the large districts established in metropolitan areas, with all district residents contributing to district cost repayment through their taxes, regardless of whether or not they are primary beneficiaries (i.e., water users) of particular developments that the district has undertaken.

Contract Terms and Provisions

The contract terms and provisions that the State adopts will, of course, have an important effect on the demand for project water and the continued financial security of its projects. The remainder of the report therefore discusses general contractual arrangements that the State might consider, recognizing that those terms and provisions ought to reflect matters of policy and procedure discussed earlier in the report.

Advance Contracts

To protect the general taxpayer by guaranteeing the financial feasibility of project undertakings, it would seem necessary that contracting agencies and districts be obligated to meet payment schedules by means of contracts entered into in advance of construction. This practice is not uncommon in private enterprise and is an

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1/ Task Force Report on Water Resources and Power, Vol. 2, 1955, p. 630 (Ref. 210).

established (though not always accomplished) policy in federal water resource development.[1] Federal experience, in fact, indicates that unless advance contracts are consummated, the State may experience considerable difficulty in contracting after project operations commence.[2]

If the State is to secure advance contracts, however, the State may find it necessary to offer firm minimum allocations of water to contracting agencies, to specify the basis of charges, and to establish maximum and minimum delivery schedules. In addition, these contracts might describe (1) the manner of payment of fixed "capacity" (or capital) charges and of variable operating charges, (2) responsibilities with respect to works required to make connections to the main canals and to distribute project water to final consumer, (3) provisions for amending contract terms to meet changed conditions at the date of first delivery and subsequently, and (4) penalties for default.

General Form of Contract

The two general types of contracts employed by the Bureau of Reclamation are "water service" contracts and "repayment" contracts. Under the former type of contract, the federal government retains permanent title to project facilities. The latter type of contract contemplates an ultimate transfer to the contracting agency of title to the physical works. In the Central Valley Project, for example, water service contracts apply with respect to the main facilities but repayment contracts apply in the case of auxiliary distribution works constructed for local interests by the Bureau.

For State projects, the most appropriate general form of contract would seem to be of the water service type, under which contracting agencies would pay a "capacity" charge (in return for a "water use" right), but would not receive title to project facilities (even though at the end of the economic lifetime of the project they would have

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1/ For recommendations in this regard see, for example, Task Force Report on Water Resources and Power, Vol. 2, 1955, p. 655 (Ref. 210).

2/ Repayment difficulties experienced by the federal government are a case in point. The Comptroller General's recent audit report on the Central Valley Project states, for example: "We believe that the repayment obligations of the beneficiaries of the. . . Kings River and Isabella Projects should be finally resolved. The projects have been serving the conservation purpose for 3 years, but the repayment arrangements have not been completed, although negotiations have been carried on for many years. . . Accordingly, we recommend that the Secretary of the Interior and the Chief of Engineers make vigorous efforts to consummate contracts for repayment of costs properly allocable. . . "--Audit Report to the Congress of the United States, 1957, p. 34 (Ref. 213).

paid for their share of the project capital costs). The large scope and multipurpose nature of most State projects does not suggest that they could eventually be turned over to local interests for ownership and operation.

Contract Periods

Discussions with potential contracting agencies to the State indicate that those agencies would favor the establishment of long-term contracts in order to protect their investments in distribution works and related land development measures. From the State's point of view as well, long-term contracts offer added repayment security. Short-term or temporary contracts could at best be used only as interim measures. It would seem reasonable and desirable therefore that the basic contract period coincide with the economic lifetime of the project (say, 50 years).1/

Contract Revisions and Renewals

If it could be presumed that water demands and project benefits and costs were accurately predictable at the time contracts were drawn, water allocations and water charges specified in the contract would never need to be altered. But, long-range projections are subject to error, and it is questionable that fixed water allocations and repayment schedules would be realistic or in the best interests of either the State or its contracting agencies.

The matter of fixed water allocations, of course, is inextricably bound up in water rights law and cannot therefore be resolved in this study. And, perhaps it should not be within the province of the State unilaterally to alter allocations once a contract is entered into. But, from the point of view of the contracting agency, it would seem desirable that some latitude be granted by which it could either obtain an increase or a decrease in its allocations to meet changing conditions. If, because of faulty predictions, an agency is required to take more water (or to pay for more capacity) than it in fact requires, then that agency must either dispose of its surplus water in some manner or bear a capacity charge that is no longer commensurate with the capacity that it actually requires. Moreover, such a requirement would tend to prevent the most economic allocation of the State's water resources, since there might be greater economic demand for that water elsewhere.

In many cases, the State may be unable physically or legally to increase the allocation to a particular agency. When surplus water

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1/ The basic contract period for Bureau of Reclamation projects is 40 years, preceded by a development period of up to 10 years, or a maximum contract period of 50 years.

is available, however, the State may well wish to increase allocations when requested to do so in order to utilize the capacity of its distribution facilities more effectively.

In the typical Bureau of Reclamation water service contract, a contracting agency is authorized to receive up to a certain maximum quantity each year during the first few years of the contract. Beyond this initial period, however, both maximum and minimum annual quantities are specified, and the minimum quantity changes automatically in accordance with a so-called "ratchet" principle. Whenever an amount greater than the stated minimum is taken in any one year, the actual amount taken becomes the new minimum for the remainder of the contract period. Since Bureau repayments are based solely on unit charges (i.e., prices per acre-foot) for water actually delivered, the "ratchet" provision helps ensure that a sufficient volume of water is sold over the lifetime of the project to effect repayment. Any reduction in the quantities delivered annually would of course jeopardize project repayment.

If, however, the State of California should adopt a capacity charge that is unrelated to the quantities of water delivered (see Section VIII), then it would be possible either to increase or decrease deliveries at any time without affecting project repayment schedules. Also, if these increases or decreases were only of a temporary nature, it would not seem essential that capacity charges be revised accordingly. If, however, a contracting agency should seek a permanent increase in its water allocation (and if the State were physically or legally able to comply) it would seem desirable that contract provisions should permit such a revision and, at the same time, provide for a corresponding increase in capacity charges.

It would seem equally desirable that downward revisions in water allocations (and, therefore, capacity charges) be permissible under the terms of project contracts so long as those revisions were offset by increases elsewhere in the system to the effect that over-all project repayment would not be jeopardized.

Thus, ideally, State contracts should specify initial annual allocations of water and related capacity charges; but, within the limitations stated above, the contracts preferably should also provide for periodic revisions at the request of the contracting agency. It should be recognized that allocations of water and capacity charges specified in advance contracts can be only estimates, and that therefore the State should preferably be able to revise those amounts within, say, a certain percentage range, at the time that actual costs and demands become known.

In addition to provisions that would permit these reassignments of water allocations and capacity charges, it would seem essential that contracts also permit automatic and periodic revisions in the

per-unit prices of project water to reflect increases or decreases in the State's operating and maintenance costs. 1/

Contracting agencies under Bureau of Reclamation projects long criticized the lack of a renewal option in water service contracts. These agencies pointed out that continued security of contract was essential if they were to commit investment to long-range developmental programs. Because of this criticism, recent Bureau contracts contain more specific renewal guarantees. Thus, for State projects it would seem equally necessary that contracts provide for perpetual renewal at the option of the contracting agency so long as that agency is not in default of contract.

1/ One of the most criticized features of Bureau of Reclamation contracts.is that they contain no provision for price revisions. Since operating costs have increased markedly in many projects, and since actual construction costs have often exceeded estimated costs, the federal government has presumably sustained substantial losses on this account.

Appendix A

CHRONOLOGICAL LISTING OF GENERAL AND SPECIAL WATER DISTRICT ACTS BY DATE OF ENACTMENT

Date of Enactment	General Acts
1867	Reclamation Districts
1880	Protection Districts
1885	Drainage Districts
1895	Protection Districts
1897	Irrigation Districts
1903	Drainage Districts
1905	Levee Districts
1907	Protection Districts
1909	Storm Water Districts
1911	Municipal Water Districts
1913	Water Districts
1913	County Water Districts
1913	County Waterworks Districts
1919	Drainage Districts
1921	Municipal Utility Districts
1921	Public Utility Districts
1921	Water Storage Districts
1927	Metropolitan Water Districts
1927	Water Conservation Districts
1931	Water Conservation Districts
1931	Flood Control and Flood Water Conservation Districts
1931	County Recreation Districts
1931	Resort Districts
1935	Municipal Water Districts
1937	Storm Drain Maintenance Districts
1941	Water Storage and Conservation Districts
1943	County Water Authorities
1951	Community Services Districts
1955	County Drainage Districts
1955	Water Replenishment Districts

Date of Enactment	Special Acts
1915	Los Angeles County Flood Control District
1927	Orange County Flood Control District
1927	American River Flood Control District
1933	Orange County Water District
1939	San Bernardino County Flood Control District
1944	Ventura County Flood Control District
1945	Humboldt County Flood Control District
1945	San Diego County Flood Control District
1945	Riverside County Flood Control and Water Conservation District
1945	San Luis Obispo County Flood Control and Water Conservation District
1945	Santa Barbara County Water Agency
1947	Monterey County Flood Control and Water Conservation District
1949	Mendocino County Flood Control and Water Conservation District
1949	Sonoma County Flood Control and Water Conservation District
1949	Alameda County Flood Control and Water Conservation District
1950	Olivehurst Public Utility District
1950	Donner Summit Public Utility District
1950	Brisbane County Water District
1951	Contra Costa County Flood Control and Water Conservation District
1951	Wake County Flood Control and Water Conservation District
1951	Wapa County Flood Control and Water Conservation District
1951	Santa Clara County Flood Control and Water Conservation District
1951	Solano County Flood Control and Water Conservation District
1951	Yolo County Flood Control and Water Conservation District
1951	Kings River Conservation District
1952	Vallejo Sanitation and Flood Control District
1952	Sacramento County Water Agency
1953	Contra Costa County Storm Drainage District
1953	Marin County Flood Control and Water Conservation District
1953	Morrison Creek Flood Control District

Date of Enactment	Special Acts (continued)
1953	San Benito County Conservation and Flood Control District
1955	Del Norte County Flood Control District
1955	Avenal Community Services District
1955	Fresno Metropolitan Flood Control District
1955	Hunters Point Reclamation District
1955	Lower San Joaquin Levee District
1955	Montalvo Municipal Improvement District
1955	Santa Barbara County Flood Control and Water Conservation District
1955	Santa Cruz County Flood Control and Water Conservation District
1955	Santa Clara-Alameda-San Benito Water Authority

Source: General Comparison of California Water District Acts, November 1955 (Ref. 109).

Appendix B

GENERAL COMPARISON OF PURPOSES AND TERRITORY OF 15 MAJOR FORMS OF PUBLIC DISTRICTS

Organizational Forms	Legal Purposes	Territory	Overlap Provisions
Community Services Districts (General Act - 1951)	Supply inhabitants with water for domestic, irrigation, sanitation, industrial, fire protection, and recreation uses; collect, treat, or dispose of sewage, waste and storm water; collect or dispose of garbage or refuse; fire protection; public recreation; street lighting; mosquito abatement; police protection; street, road, and drainage work; may supply water solely for irrigation.	Any unincorporated territory in one or more counties.	No provision.
County Water Agencies[1]			
Santa Barbara County Water Agency (Special Act - 1945)	To make water available for present and future beneficial uses of the lands or inhabitants, including irrigation, domestic, fire protection, municipal, commercial, industrial and all other beneficial uses; to develop power incidental to authorized projects for use by the agency in the operation of its works; to control the flood and storm waters of the agency and of streams flowing into the agency, to conserve such waters by storage in surface reservoirs, to release such water for underground replenishment, to divert and transport such waters for beneficial uses within the agency, to reduce waste of water and to protect life and property from floods in conjunction with Section 4 projects.	All of Santa Barbara County.	Shall not impair existence of other public districts, municipalities or public agencies established for flood control, reclamation, conservation, storage, distribution, sale, use or development of water.
County Water Authorities			
County Water Authority Act (General Act - 1943)	To acquire water and water rights within or without the State (but not within the county); to develop, store and transport water; to provide, sell and deliver water at wholesale for municipal, domestic and other beneficial uses and purposes, with preference to member "agencies"; to provide, sell and deliver surplus water, with preference to the area within the authority.	Two or more "public agencies" (any municipal corporation, municipal water district, municipal utility district, public utility district, county water district, irrigation district, or any similar public corporation or agency with power to acquire and distribute water) in any county; need not be contiguous.	Composed of 2 or more "public agencies" maintaining separate entities.
Santa Clara-Alameda-San Benito Water Authority (Special Act - 1955)	To acquire water and water rights within or without the State, but not within the counties in which the authority is located; to develop, store and transport such water; to provide, sell or deliver water at wholesale for municipal, domestic, irrigation and other beneficial purposes, with preference to member agencies; may exercise powers of irrigation districts except may not develop and sell hydroelectric power or issue bonds.	Approving "public agencies" (any public corporation, public district, or state agency having power to acquire and distribute water) within the counties of Santa Clara, Alameda, and San Benito.	Member agencies retain separate identity.
County Water Districts (General Act - 1913)	Furnish water for any present or future beneficial use; store and conserve water, acquire water rights, and operate works to supply or make use of water for any beneficial use; salvage sewage and storm waters; generate and sell at wholesale incidental hydroelectric power; acquire and operate sewer facilities; sell or lease oil or mineral rights; in cooperation with U.S. acquire and operate works for irrigation, or development of power and provide recreational facilities; own and operate fire-fighting equipment; drain and reclaim lands; acquire, conserve or dispose of flood and storm water; districts declared public agencies of the State.	County, two or more contiguous counties, or any portion.	Lands in district in existence not less than 5 years and not furnishing water may be included in irrigation districts; a district may be annexed to or included within a Municipal Utility District without impairing legal existence; may overlap irrigation district.
County Waterworks Districts (General Act - 1913)	Develop, conserve and supply inhabitants of district with water for irrigation, domestic or fire protection purposes.	Any unincorporated portion of a county, or the whole or any portion of one or more incorporated cities and contiguous unincorporated territory, and not included in a county irrigation or county waterworks district; may include non-contiguous territory of not less than 10 privately owned acres which may be supplied through same distribution system.	Prohibited.

Organizational Forms	Legal Purposes	Territory	Overlap Provisions
Flood Control and Water Conservation Districts[2/]			
Solano County Flood Control and Water Conservation District	Make water available for present or future beneficial uses of the lands or inhabitants, including irrigation, domestic, fire protection, municipal, commercial, industrial and all other beneficial uses; control flood and storm waters of the district and of streams flowing into the district, conserve such waters by storage in surface reservoirs, divert and transport such waters for beneficial uses within the district, release such water for underground replenishment, reduce waste of water, protect life and property from floods, all in conjunction with Sec. 4 projects.	All of Solano County, any member unit outside the county (any contiguous city), and the Davis Campus of the University of California.	Shall not affect any municipality, public district or agency now or hereafter established for flood control, reclamation, conservation, storage, distribution, sale, use or development of water.
Irrigation Districts (General Act - 1897)	Furnish water for, and put water to any beneficial use, control, distribute, salvage, etc., any water, including sewage, for beneficial use, provide drainage, develop and distribute electric power, operate airport, aviation school. Flood control by districts of 200,000 acres or more. Districts are declared state agencies.	Land irrigable from common source and by same system; need not be contiguous; includes residential and business.	New districts may not include land in another irrigation district without consent of Board of existing district.
Metropolitan Water Districts (General Act - 1927)	Develop, store and distribute water for municipal and domestic purposes.	Two or more "municipalities" (city, city and county, municipal water district, municipal utility district, public utility district, county water district, or county water authority); need not be contiguous.	See "Territory"; legal existence of constituent units not impaired.
Municipal Utility Districts (General Act - 1921)	Supply inhabitants of the district and "public agencies" therein with light, water, power, heat, transportation, telephone service, or other means of communication or means for collection or disposition of garbage, sewage or refuse matter.	Any "public agency" (city, county water district, county sanitation district or sanitary district) together with unincorporated territory, or two or more "public agencies" with or without unincorporated territory; may be in same or separate counties and need not be contiguous; no "public agency" shall be divided.	No provision.
Municipal Water Districts (General Act - 1911)	To acquire waterworks, water rights, conduits, reservoirs, etc.; to store, convey, supply or otherwise make use of water for a waterworks plant or system for benefit of the district; to sell water to cities, public and private corporations and agencies, persons or inhabitants, in the district only, unless there is a surplus; to supply water to publicly operated golf courses or other recreational facilities and public schools; to salvage and distribute sewage, storm and other waters.	Any county or portion of a county or lands in more than one county; may consist of either incorporated or unincorporated territory alone, or both; if city included, its entire corporate area must be included, with certain exceptions; lands need not be contiguous.	Identity or legal existence of any public corporation or agency is not impaired by inclusion in district; no public corporation or agency having same purpose may be formed in a district without its consent.
Public Utility Districts (General Act - 1921)	Acquire and operate, within or without district, works for supplying inhabitants with light, water, power, heat, transportation, telephone or other means of communication, means for disposition of garbage, sewage or refuse matter; purchase and distribute such services and commodities; acquire and operate a fire department, public works, playgrounds, swimming pools, recreation and other public buildings.	Any unincorporated territory.	Powers of district transferred to city or town whenever all territory of the district becomes a part of any incorporated city or town.

Organizational Forms	Legal Purposes	Territory	Overlap Provisions
Reclamation Districts (General Act - 1867)	To reclaim and protect land from overflow; irrigate lands inside or outside district.	Any body of swamp and overflowed, salt-marsh, or tidelands, or other lands subject to flood or overflow, susceptible of one mode of reclamation.	Authorized in Yolo and Solano Counties.
Water Conservation Districts			
Water Conservation Act (General Act - 1931)	Conserve and store water by dams, reservoirs, ditches, spreading basins, sinking wells, sinking basins, etc.; appropriate, acquire and conserve water and water rights for any useful purpose; obtain water from wells; sell, deliver, distribute or otherwise dispose of water; make surveys and protect water supplies by legal action; provide recreational facilities; reclaim sewage and storm waters.	The whole or a part or parts of one or more watersheds of any stream or streams of water or unnavigable river or rivers,or territory adjacent thereto or deriving a water supply therefrom; may be entirely within unincorporated territory or partly within incorporated territory; may be within one or more counties; need not be contiguous.	No provision.
Kings River Conservation District (Special Act - 1951)	Conservation, development, control, distribution and use of the waters of the Kings River and its tributaries and power developed thereby; protection, drainage and reclamation of lands within the district; protection and preservation of rights to water therein; meet various problems affecting such water supply.	Certain described territory (comprising, in general, the Kings River Water Service Area) in the Counties of Fresno, Tulare and Kings.	Does not affect or supersede any other district now or hereafter established in the area.
Water Districts (General Act - 1913)	Produce, store and distribute water for irrigation, domestic, industrial and municipal purposes, drain and reclaim lands incidental thereto or connected therewith; such uses of water declared a public use.	Lands susceptible of irrigation from a common source and by same system of works; must be contiguous unless not more than two miles apart or separated by State hospital land.	Lands in district in existence not less than five years and not delivering water may be included in an irrigation district; under contract with U. S., State agency or district, lands may become part of any irrigation, drainage or reclamation project.
Water Storage Districts (General Act - 1921)	Storage and distribution of water; drainage and reclamation in connection therewith; generation and distribution of power incidental thereto; such uses are a public use.	Lands already irrigated or susceptible of irrigation from a common source and by same system; need not be contiguous.	May include land in other agencies including other water storage districts having different plans, purposes, and objects.

1/ Though the special act enabling the Sacramento County Water Agency does not include development of power it is in all other respects regarding purposes and territory essentially identical.

2/ The example used is one of ten special act flood control and water conservation districts empowered to acquire and sell water for beneficial uses.

Source: General Comparison of California Water District Acts, November 1955 (Ref. 109).

Appendix C

LIST OF ORGANIZATIONS AND AGENCIES CONTACTED

Arvin-Edison Water Storage District, Arvin
Bank of America National Trust & Savings Association, San Francisco
Bear Valley Mutual Water Company, Redlands
J. G. Boswell Company, Los Angeles
State of California:
- Department of Water Resources, Glendale, Los Angeles, and Sacramento
- Deputy Attorney General's Office, Los Angeles
- Districts Securities Commission, San Francisco
- Legislative Analysts Office, Sacramento
- Public Utilities Commission, Los Angeles

California Farm Bureau Federation, Berkeley
California Water Development Council, Fresno, Los Angeles, and Sacramento
Chowchilla Water District, Chowchilla
East Bay Municipal Utility District, Oakland
Eastern Municipal Water District, Hemet

Feather River Project Association, Los Angeles
Walter M. Gleason, attorney, Los Angeles
Giannini Foundation of Agricultural Economics, Berkeley
Irrigation Districts Association of California, San Francisco
Jennings, Engstrand & Henrikson, attorneys, La Mesa

Jones, Griswold & Henley, attorneys, San Jose
Kern County Farm Bureau, Water Problems Department, Bakersfield
Kern County Land Company, Bakersfield
Kings River Conservation District, Fresno
Los Angeles Department of Water and Power, Los Angeles

Metropolitan Water District of Southern California, Los Angeles
Municipal Water Department of the City of San Bernardino, San Bernardino
Northern Colorado Water Conservancy District, Loveland, Colorado
Orange County Municipal Water District, Santa Ana
Pacific Gas & Electric Company, San Francisco

San Bernardino Valley Municipal Water District, San Bernardino
San Diego County Water Authority, San Diego
San Diego State College, San Diego
San Francisco Water Department, San Francisco
San Joaquin Valley Water Users Association, San Francisco

Santa Clara Valley Water Conservation District, San Jose
Semitropic Water Storage District, Wasco
Shafter-Wasco Irrigation District, Shafter
Southern California Water Coordinating Conference, Los Angeles
Southern Pacific Land Company, Hanford

Stoddard and Karrer, engineering consultants, Fresno and Los Banos
Tejon Ranch Company, Fort Tejon
Tri-County Water Authority, San Jose
Tulare Lake Basin Water Storage District, Corcoran
Union-Tribune Publishing Company, San Diego

U.S. Bureau of Reclamation, Fresno and Sacramento
U.S. Federal Power Commission, San Francisco
University of California, Berkeley, Davis, and Los Angeles
University of Southern California, Los Angeles
Water Association of Kern County, Bakersfield

Water Department, City of San Diego, San Diego
Western Municipal Water District of Riverside County, Riverside
Westlands Water District, Fresno
Wheeler Ridge-Maricopa Water Storage District, Wheeler Ridge

Appendix D

REFERENCES

Books and Monographs

Ref. No.	
1	Allen, S. W. *Conserving Natural Resources, Principles and Practice in a Democracy*. New York: McGraw-Hill, 1955.
2	American Water Works Association. *Water Rates Manual.* New York: American Water Works Association, 1957.
3	Bank of America National Trust and Savings Association, Economics Department. *Is There Water for California?* prepared by S. Brubaker. San Francisco: Bank of America, September 1955.
4	Beckwith, B. P. *Marginal-Cost Price-Output Control.* New York: Columbia University Press, 1955.
5	Bogart, E. L. *The Water Problem of Southern California.* ("Illinois Studies in the Social Sciences," XIX, No. 4.) Urbana, Illinois: University of Illinois, 1934.
6	California Farm Bureau Federation. *Farm Bureau Water Policy, 1919 to 1954*. Berkeley: California Farm Bureau Federation, n.d.
7	California State Chamber of Commerce, Industrial Plant Location Committee. *Standard Industrial Survey, Summary Reports for California Communities*. Sacramento, 1955.
8	California State Chamber of Commerce, Statewide Water Resources Committee. *Report of the Sub-Committee on "Areas of Origin"*. San Francisco, November 30, 1956.
9	California Water Conference. *Proceedings of the California Water Conference.* Conference called by Gov. E. Warren, Sacramento, December 6 and 7, 1945.
10	California Water Conference. *Proceedings of the California Water Conference.* Conference sponsored by California State Chamber of Commerce, Los Angeles, February 23, 1956.
11	Cassady, R., Jr. *Price Making and Price Behavior in the Petroleum Industry*. ("Petroleum Monograph Series," vol. I.) New Haven: Yale University Press, 1954.
12	Ciriacy-Wantrup, S. V. *Resource Conservation, Economics and Policies*. Berkeley: University of California Press, 1952.
13	Clark, J. M. *Studies in the Economics of Overhead Costs.* Chicago: University of Chicago Press, 1950.
14	Clemens, E. W. *Economics and Public Utilities*. New York: Appleton-Century-Crofts, 1950.
15	Dewhurst, J. F. and Associates. *America's Needs and Resources: A New Survey*. New York: Twentieth Century Fund, 1955.
16	Dooher, M. J., ed. *Production and Marketing Problems: A Coordinated Approach*. ("American Management Association, General Management Series," No. 172.) New York: American Management Association, 1954.
17	Engineers Joint Council. *National Water Policy, a Statement of Desirable Policy with Respect to the Conservation, Development and Use of the National Water Resources*. 2nd ed. New York: Engineers Joint Council, October 1950.
18	Engineers Joint Council. *A Water Policy for the United States; a Critique of the Report of the President's Water Resources Policy Commission by the National Water Policy Panel of Engineers Joint Council*. New York: Engineers Joint Council, 1951. Pp. 5.
19	Folz, W. E. *The Economics of Water Resources Development: A Theoretical Analysis*. Moscow, Idaho, 1951.
20	Graham, J. B. and M. F. Burrill, eds. *Water for Industry.* ("American Association for the Advancement of Science," Publication No. 45.) Washington, 1956.
21	Grant, E. L. *Principles of Engineering Economy*. 3rd ed. New York: Ronald Press, 1950.
22	Hansen, A. H. and H. S. Perloff. *Regional Resource Development*. ("National Planning Association, Planning Pamphlets," No. 16.) Washington, October 1942.
23	Huffman, R. E. *Irrigation Development and Public Water Policy*. New York: Ronald Press, 1953.
24	Hutchins, W. A. *The California Law of Water Rights.* Sacramento: State Printing Office, 1956.
25	Inland Empire Waterways Association. *Yours Is the River, the ABC of Columbia-Snake River Development*. Walla Walla, Washington: Inland Empire Waterways Association, n.d.
26	Ireson, W. G. and E. L. Grant, eds. *Handbook of Industrial Engineering and Management*. Englewood Cliffs, N. J.: Prentice-Hall, 1955.
27	Irrigation Districts Association of California. *Minutes of Biennial Convention*, Sacramento, March 20-22, 1957. San Francisco: Irrigation Districts Association of California, 1957.
28	Lagerquist, W. E. *Public Utility Finance*. Chicago: A. W. Shaw, 1927.
29	Little, I. M. D. *A Critique of Welfare Economics*. Oxford: Clarendon Press, 1950.
30	Metropolitan Water District of Southern California. *Colorado River Aqueduct*. Los Angeles: Metropolitan Water District of Southern California, March 1939.
31	Metropolitan Water District of Southern California. *Report for the Fiscal Year: July 1, 1954 to June 30, 1955*. Los Angeles: Metropolitan Water District of Southern California, 1955.
32	Metropolitan Water District of Southern California. *Report for the Fiscal Year: July 1, 1955 to June 30, 1956*. Los Angeles: Metropolitan Water District of Southern California, 1956.
33	Metropolitan Water District of Southern California. *Water Needs and Financial Aspects of the Metropolitan Water District Project*. Los Angeles: Metropolitan Water District of Southern California, April 1931.
34	Moley, R. *What Price Federal Reclamation?* ("American Enterprise Association Series, National Economic Problems," No. 455.) New York: American Enterprise, 1955.
35	Montana State College, Agricultural Experiment Station. *Bulletin 517: Indirect Benefits of Irrigation Development, Methodology and Measurement*. Bozeman: Montana State College, March 1956.
36	Montana State College, Extension Service. *State and Federal Programs Which Provide Aid in Water Control and Development*. Bozeman: Montana State College, 1955.
37	Nadeau, R. A. *The Water Seekers*. Garden City, N. Y.: Doubleday, 1950.
38	Nardi, H. C. *The Central Valley Project of California: A Bibliography.* Sacramento: California Legislative Counsel, 1952. Pp. 57.
39	National Reclamation Association. *Proceedings of the 23d Annual Meeting of the National Reclamation Association at Portland, Oregon, November 8-10, 1954*. Washington, 1954.
40	Northern Colorado Water Conservancy District. *Northern Colorado Water Conservancy District and Colorado Big Thompson Project Progress Report, January 1954*. Loveland: Northern Colorado Water Conservancy District, 1954.
41	Northern Colorado Water Conservancy District. *Northern Colorado Water Conservancy District Secretary-Manager's Report, 1956*. Loveland: Northern Colorado Water Conservancy District, n.d.
42	Oakland County Planning Commission. *Industrial Water Needs*. Oakland County, Michigan, 1957.
43	Orange County Board of Supervisors. *Orange County Progress Report*, I, No. 8 (August 1957), prepared by R. I. Morris, Santa Ana, Courthouse.
44	Orange County Board of Supervisors. *Preliminary County Budget of the County of Orange, California for the Fiscal Year Ending June 30, 1958*. Santa Ana, Calif., 1957.

Ref. No.

45 Orange County Board of Supervisors, et al. *Your Orange County Government.* 3rd ed. Santa Ana, Calif: Dennis Printers, 1956.

46 Ostrom, V. *Metropolitan Los Angeles, a Study in Integration; VIII. Water Supply.* Los Angeles: Haynes Foundation, 1953.

47 Ostrom, V. *Water & Politics: A Study of Water Policies and Administration in the Development of Los Angeles.* Los Angeles: Haynes Foundation, 1953.

48 Owen, W. *A Mid-Century Look at Resources.* Washington: Brookings Institution, 1954. Pp. 20.

49 Packard, W. E. *The Economic Implications of the Central Valley Project.* Los Angeles: Adcraft, 1942.

50 Parson, R. L. *Conserving American Resources.* Englewood Cliffs, N. J.: Prentice-Hall, 1956.

51 The RAND Corporation. *A Brief Survey of the Technology and Economics of Water Supply,* by J. C. DeHaven, L. A. Gore, and J. Hirshleifer. 2nd ed. Report R-258-RC. Santa Monica, Calif.: The RAND Corporation, 1955.

52 Resources for the Future, Inc. *Annual Report for the Year Ending September 30, 1957.* Washington, D. C.: Resources for the Future, December 1957.

53 Resources for the Future, Inc. *The Nation Looks at Its Resources.* Report of the Mid-Century Conference on Resources for the Future, Washington, D. C., December 2-4, 1953. Menasha, Wisconsin: George Banta, 1954.

54 San Benito County Water Conservation and Flood Control District. *Irrigation Water Costs and the Economic Limits of Water Charges for Selected Crops in San Benito County, California (An Analysis),* prepared by University of California, Agricultural Extension Service, San Benito County, 1956.

55 San Diego County Water Authority. *Report on Water Supply for Probable Future Developments in the San Diego County Water Authority,* September 12, 1955. San Diego: County Board of Engineers, 1955.

56 San Diego Water Department. *Annual Financial Report of the City of San Diego Water Department for the Fiscal Year Ended June 30, 1957.* San Diego, 1957.

57 San Francisco Public Utilities Commission. *Annual Report, 1955-1956.* San Francisco: Public Utilities Commission, 1956.

58 San Francisco Public Utilities Commission. *San Francisco Water and Power.* San Francisco: Calmar Printing, 1949.

59 Santa Clara-Alameda-San Benito Water Authority. *Report on Investigation of Costs for Importing Water to the Tri-County Service Area by the Del Puerto Canyon, Orestimba Canyon and Pacheco Pass Routes and Cost Estimating Data for Santa Clara-Alameda-San Benito Water Authority,* prepared by Creegan and D'Angelo, San Jose-Saratoga, September 1957.

60 Santa Clara-Alameda-San Benito Water Authority. *Supplemental Water Requirements of Santa Clara, Alameda and San Benito Counties in California.* San Jose: Santa Clara-Alameda-San Benito Water Authority, May 1, 1957.

61 Santa Clara Valley Water Conservation District. *Report to the Honorable Board of Directors of the Santa Clara Valley Water Conservation District on Revised 1956 Waste Water Salvage Project.* San Jose: Santa Clara Valley Water Conservation District, March 8, 1956.

62 Santa Clara Valley Water Conservation District. *Water for the Valley, a Quarter-Century Record of the Santa Clara Valley Water Conservation District, 1929-1954.* San Jose: Santa Clara Valley Water Conservation District, November 12, 1954. Pp. 15.

63 Scattergood, E. F. *Organization, Financing, and Operation of Publicly Owned Electric and Gas Utilities.* Washington: Government Printing Office, 1936. Pp. 58.

64 Shih, Yang-ch'eng. *American Water Resources Administration.* 2 vols. New York: Bookman Associates, 1956.

65 Smith, A. *The Wealth of Nations.* The Modern Library Edition. New York: Random House, 1937.

66 Soth, L. *Farm Trouble.* Princeton, N. J.: Princeton University Press, 1957.

67 Stanford Research Institute. *Demand for Water in Service Areas of the Feather River Project.* (SRI Project No. I-1512.) Menlo Park, 1955. (Published as Appendix A to Bechtel Corporation Report, Ref. 145.)

Ref. No.

68 Stanford Research Institute. *Economic and Financial Aspects of Public Ownership of the Concord Water System.* (SRI Project No. I-1522) Menlo Park, 1956.

69 Stanford Research Institute. *An Economic Study of the Ventura River Municipal Water District.* (SRI Project No. I-1176) Menlo Park, 1955.

70 Stanford Research Institute. *Municipal Water Rates in the Eleven Western States.* Draft Report, Project 52140-11.

71 Stigler, G. J. *The Theory of Price.* New York: Macmillan, 1952.

72 Stone, A. W., ed. *Proceedings of the First Annual Water Resources Conference: Is a Preference Among Distributors of Federal Power Justified?* Montana State University, July 20 and 21, 1956. Missoula, Montana: Montana State University Press, 1957.

73 Thompson, W. S. *Growth and Changes in California's Population.* Los Angeles: Haynes Foundation, 1955.

74 Twentieth Century Fund. *Electric Power and Government Policy.* New York: Twentieth Century Fund, 1948.

75 University of California, Bureau of Public Administration. *Recreational Use of Water Supply Reservoirs.* (1957 Legislative Problems, No. 8.) Prepared by S. Scott and J. F. McCarty. Berkeley: University of California, April 1957.

76 University of California, College of Agriculture. *Northern Kern County Cotton-Potato Farms (No. 1: Organization, Inputs and Costs),* by C. O. McCorkle, Jr. and T. R. Hedges. Calif. Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, October 1952.

77 University of California, Committee on Research in Water Resources. *Proceedings: Conference on Industrial Uses of Water in California.* Los Angeles, December 10-11, 1956.

78 University of California, Committee on Research in Water Resources. *Proceedings: Conference on Recreational Use of Impounded Water.* Richmond, Calif., December 13-14, 1956.

79 University of California, Committee on Research in Water Resources. *Report on Recent and Current Research in Water Resources.* October 1957.

80 University of California, Division of Agricultural Sciences. *Farm Adjustments and Earnings Under 1955 Cotton Acreage Allotments, 1: Upper San Joaquin Valley Cotton Farms, 1953-55,* by T. R. Hedges. Calif. Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, December 1956.

81 University of California, Division of Agricultural Sciences. *Farm Adjustments and Earnings Under 1955 Cotton Acreage Allotments, 2: Small Grape Cotton Farms on the San Joaquin Valley Eastside, 1953-1955,* by D. C. Athanassotos and T. R. Hedges. Calif. Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, May 1957.

82 University of California, Division of Agricultural Sciences. *Inputs and Costs for Producing Field Crops (A Statistical Supplement to Farm Adjustments and Earnings Under 1955 Cotton Acreage Allotments), 1: Upper San Joaquin Valley Cotton Farms, 1953-55,* by T. R. Hedges. Calif. Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, December 1956.

83 Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development. *Water Resources and Economic Development of the West, Report No. 1: Research Needs and Problems.* Conference Proceedings, Berkeley, March 2-3, 1953.

84 Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development. *Water Resources and Economic Development of the West, Report No. 2: Institutions and Policies.* Conference Proceedings, Bozeman, Montana, June 28-30, 1954.

85 Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development. *Water Resources and Economic Development of the West, Report No. 3: Benefit-Cost Analysis.* Papers presented at meeting of Sections K and M of the American Association for the Advancement of Science, Berkeley, December 27, 1954.

86 Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development. *Water Resources and Economic Development of the West, Report No. 4: Impact and Measurement, Organizational Integration, Small Watershed Development, and Desert Land Development.* Conference Proceedings, Pullman, Washington, June 27-29, 1955.

Ref. No.

87 Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development, and Western Regional Research Committee W-42. Water Resources and Economic Development of the West, Report No. 5: Ground Water Economics and the Law. Conference Proceedings, Berkeley, December 20-21, 1954.

88 Western Municipal Water District of Riverside County. First Annual Report, 1955. Riverside: Western Municipal Water District of Riverside County, 1955.

89 Western Municipal Water District of Riverside County. Second Annual Report, 1956. Riverside: Western Municipal Water District of Riverside County, 1956.

90 Wilbur, R. L. and N. Ely. The Hoover Dam Documents. 2nd ed. (80th Cong., 2d Sess., H. Doc. No. 717.) Washington: Government Printing Office, 1948.

91 Wilbur, R. L. and N. Ely. The Hoover Dam Power and Water Contracts and Related Data. Washington: Government Printing Office, 1933.

92 Williams, A. N. The Water and the Power. New York: Duell, Sloan & Pearce, 1951.

93 Wilson, G. L., J. M. Herring and R. B. Eutsler. Public Utility Industries. New York: McGraw-Hill, 1936.

94 Zettel, R. M. Highway Benefit and Cost Analysis As an Aid to Investment Decision. (Reprint No. 49.) Distributed by Institute of Transportation and Traffic Engineering, University of California. Pp. 4.

State of California Publications

95 California. Attorney General. "Proposed Water Rights Constitutional Amendment," to accompany Report of Water Lawyers' Committee to Governor Goodwin J. Knight, April 29, 1957, reproduced by Irrigation Districts Association of California, San Francisco, 1957.

96 California. Attorney General. Report to Edmund G. Brown, Attorney General of California by the Attorney General's Committee of Water Lawyers on County of Origin Problems. Sacramento, January 3, 1957. Pp. 71.

97 California. Controller. Annual Report of Financial Transactions Concerning Counties of California, Fiscal Year 1955-56. Sacramento, 1957.

98 California. Controller. Annual Report of Financial Transactions Concerning Irrigation Districts of California, Calendar Year 1951, 1952; 1953; 1954; 1955; 1956. Sacramento, 1954; 1954; 1955; 1956; 1957.

99 California. Controller. Annual Report of Financial Transactions Concerning Special Districts of California, Fiscal Year 1953-54, 1954-55, 1955-56. Sacramento, 1955; 1956; 1957.

100 California. Department of Engineering. Bulletin No. 2: Irrigation Districts in California, 1887-1915. Sacramento, 1916.

101 California. Department of Public Works. Views of the State of California on Elements of a National Water Resources Policy Submitted to the President's Water Resources Policy Commission. Sacramento, June 1950.

102 California. Department of Public Works, Division of Engineering and Irrigation. Bulletin No. 6: Irrigation Requirements of California Lands. Sacramento, 1923.

103 California. Department of Public Works, Division of Engineering and Irrigation. Bulletin No. 8: Cost of Water to Irrigators in California. Sacramento, 1925.

104 California. Department of Public Works, Division of Water Resources. Bulletin No. 21-P: Report on Irrigation Districts in California, 1944-1950. Sacramento, n. d.

105 California. Department of Public Works, Division of Water Resources. Bulletin No. 36: Cost of Irrigation Water in California. Sacramento, 1930.

106 California. Department of Public Works, Division of Water Resources. Bulletin No. 37: Financial and General Data Pertaining to Irrigation, Reclamation and Other Public Districts in California. Sacramento, 1930.

107 California. Department of Public Works, Division of Water Resources. Bulletin No. 43, South Coastal Basin Investigation: Value and Cost of Water for Irrigation in Coastal Plain of Southern California. Sacramento, 1933.

Ref. No.

108 California. Department of Public Works, Division of Water Resources. Dams Within Jurisdiction of the State of California. Sacramento, January 1, 1956.

109 California. Department of Public Works, Division of Water Resources. General Comparison of California Water District Acts. Sacramento, November 1955.

110 California. Department of Public Works, Division of Water Resources. Program for Financing and Constructing the Feather River Project as the Initial Unit of the California Water Plan. Sacramento, February 1955.

111 California. Department of Water Resources. Bulletin 40-57: Quality of Surface and Ground Waters in Upper Santa Ana Valley. Sacramento, June 1957.

112 California. Department of Water Resources. Challenge in California. Sacramento, 1956.

113 California. Department of Water Resources. Economic Impact of the Construction of Oroville Dam and Power Plant upon the Oroville Area. Sacramento, October 1956.

114 California. Department of Water Resources. "History of Investigation Leading to Formulation of the California Water Plan," November 30, 1956. Pp. 19.

115 California. Department of Water Resources. Letter from Harvey O. Banks, Director, Department of Water Resources, to Joseph Jensen, Chairman, Board of Directors, Metropolitan Water District of Southern California, October 22, 1956.

116 California. Department of Water Resources. Letter from Harvey O. Banks, Director, Department of Water Resources, to Hon. Luther H. Lincoln, Chairman, Joint Committee on Water Resources Development Problems, August 30, 1957.

117 California. Department of Water Resources. Letter from Harvey O. Banks, Director, Department of Water Resources, transmitting recommendations of the Department with respect to the 'County of Origin' problem to Hon. Patrick McGee, Chairman, Subcommittee Joint Legislative Committee on Water Problems, January 4, 1957.

118 California. Department of Water Resources. "Statement of the Department of Water Resources Regarding Alternative Plans for Water Development in California," Sacramento, January 18, 1957. Pp. 13.

119 California. Department of Water Resources. "Summary of Comments and Letters in Regard to Bidwell Bar Project on the Feather River," Sacramento, March 4, 1957.

120 California. Department of Water Resources. Views of the California State Department of Water Resources on United States Senate Resolution 281, 84th Congress, 2d Session. Sacramento, November 1956.

121 California. Department of Water Resources, Division of Design and Construction. "Estimated Feather River Project Fund Requirements Through Fiscal Year 1967," Sacramento, April 2, 1957. Pp. 1.

122 California. Department of Water Resources, Division of Resources Planning. Bulletin No. 3: The California Water Plan. Sacramento, May 1957.

123 California. Department of Water Resources, Division of Resources Planning. Bulletin No. 59: Investigation of Upper Feather River Basin Development. Interim Report on Engineering, Economic and Financial Feasibility of Initial Units. Sacramento, February 1957.

124 California. Department of Water Resources, Division of Resources Planning. Bulletin No. 60: Interim Report to the California State Legislature on the Salinity Control Barrier Investigation. Sacramento, March 1957.

125 California. Department of Water Resources, Division of Resources Planning. Bulletin No. 61, Feather River Project: Investigation of Alternative Aqueduct Routes to San Diego County. (Preliminary, Subject to Revision.) Sacramento, 1957.

126 California. Districts Securities Commission. Report upon Activities of the California Districts Securities Commission with Particular Reference to Calendar Years 1954 and 1955. Sacramento, 1956.

127 California. Governor. Citizens' Conference on Water Problems Convened by Governor Goodwin J. Knight. Sacramento, November, 19, 1956.

Ref. No.	
128	California. Governor. Views of the State of California on Water Resources and Power Functions of Federal Departments and Agencies Submitted to the Commission on Organization of the Executive Branch of the Government Task Force on Water Resources and Power. Sacramento, May 3, 1954.
129	California. Legislative Analyst. Economics of a State Water Resources Program. Sacramento, July 9, 1957. Pp. 60.
130	California. Legislative Auditor. Analysis of Assembly Constitutional Amendments No. 38, 55, 68. Sacramento, April 17, 1957. Pp. 7.
131	California. Legislative Auditor. Analysis of Assembly Constitutional Amendment Nos. 38, 55, 68, Supplemental Report on Pay-As-You-Go Financing. Sacramento, April 26, 1957. Pp. 5.
132	California. Legislative Auditor. Considerations in Financing a State Water Resources Development Program. Sacramento, November 13, 1956. Pp. 29.
133	California. Legislative Auditor. Flood Control Fund of 1946. Sacramento, August 1, 1956. Pp. 21.
134	California. Legislative Auditor. Remarks Made to Assembly Meeting as a Committee of the Whole on ACA 38 and ACA 55. Sacramento, May 16, 1957. Pp. 6.
135	California. Legislature, Assembly. Assembly Bill No. 4. Sacramento, April 25, 1956.
136	California. Legislature, Assembly. Assembly Bill No. 56, introduced by Mr. Lowrey, referred to Committee on Conservation, Planning, and Public Works. Sacramento, March 16, 1956. Pp. 12.
137	California. Legislature, Assembly. Assembly Concurrent Resolution No. 198. Sacramento, June 1957.
138	California. Legislature, Assembly. Assembly Constitutional Amendment No. 81. Sacramento, June 9, 1957.
139	California. Legislature, Assembly. Basic Principles for State-Wide Water Development. Report of the Southern California Water Coordinating Conference. Sacramento, January 14, 1957.
140	California. Legislature, Assembly Interim Committee on Conservation, Planning, and Public Works. Central Valley Project: Federal or State? (Assembly Interim Committee Reports, 1953-1955, XIII, No. 6.) Prepared by Bureau of Public Administration, University of California, Berkeley. Sacramento, 1955.
141	California. Legislature, Assembly Interim Committee on Conservation, Planning, and Public Works. Irrigation District Movement in California, a Summary (Section I). (Assembly Interim Committee Reports, 1953-1955, XIII, No. 5.) Prepared by Bureau of Public Administration, University of California, Berkeley. Sacramento, 1955.
142	California. Legislature, Assembly Interim Committee on Conservation, Planning, and Public Works. Water District Laws of California, an Analysis (Section 2). (Assembly Interim Committee Reports, 1953-1955, XIII, No. 5A.) Prepared by Legislative Counsel. Sacramento, 1955.
143	California. Legislature, Assembly Interim Committee on Government Organization. A Department of Water Resources for California. Sacramento, February 8, 1956.
144	California. Legislature, Assembly Interim Committee on Municipal and County Government. Analysis of California District Laws, 1954. Sacramento, 1955.
145	California. Legislature, Joint Committee on Water Problems. Eighth Partial Report on Water Problems of the State of California: Report on the Engineering, Economic and Financial Aspects of the Feather River Project, [by] Bechtel Corporation, December 31, 1955. Sacramento, March 1956. (Report also published by Bechtel Corporation, San Francisco.)
146	California. Legislature, Joint Committee on Water Problems. Hearing of the Joint Committee on Water Problems, San Diego December 17, 1957. Sacramento: Alice Book, 1957.
147	California. Legislature, Joint Committee on Water Problems. Hearing of the Joint Committee on Water Problems, San Francisco, October 23, 1957. Sacramento: Alice Book, 1957.
148	California. Legislature, Joint Committee on Water Problems. Hearing of the Joint Committee on Water Problems, Subcommittee on Economic Financial Feasibility of Water Projects, San Francisco. October 24, 1957. Sacramento: Alice Book, 1957.
149	California. Legislature, Joint Committee on Water Problems. Hearing of the Joint Committee on Water Problems, Subcommittee on Financial and Economic Policy for State Water Projects, Los Angeles, November 12, 1957. Sacramento: Alice Book, 1957.
150	California. Legislature, Joint Committee on Water Problems. Hearing of the Joint Committee on Water Problems, Subcommittee on Financial and Economic Policy for State Water Projects, Los Angeles, November 13, 1957. Sacramento: Alice Book, 1957.
151	California. Legislature, Joint Committee on Water Problems. Hearing of the Subcommittee on Financial and Economic Policy for State Water Projects, Sacramento, December 20, 1957. Sacramento: Alice Book, 1957.
152	California. Legislature, Joint Committee on Water Problems. Meeting of the Sub-Committee on Financial and Economic Policy for State Water Projects, Sacramento, January 29, 1958. Placerville, California: Harold Krabbenhoft, 1958.
153	California. Legislature, Joint Committee on Water Problems. Seventh Partial Report: Proposals for a State Department of Water Resources, Water Problems of Counties of Origin, Underground Water Problems, Water Problems of Imperial and Palo Verde Valleys. Sacramento, February 1955.
154	California. Legislature, Joint Committee on Water Problems. Tenth Partial Report: Drainage Problems of the San Joaquin Valley of California. Sacramento, March 1957.
155	California. Legislature, Joint Committee on Water Problems. Third Partial Report: Review of the Water Project Authority Report Entitled "Feasibility of State Ownership and Operation of the Central Valley Project of California" (dated March 1952) Including Supplemental Water Supply Studies and Revised Financial Analyses. Sacramento, October 1953.
156	California. Legislature, Senate. Senate Bill No. 1631. Sacramento, June 12, 1957.
157	California. Legislature, Senate. Senate Bill No. 2174. Sacramento, January 24, 1957.
158	California. Public Utilities Commission. Annual Report, 1954-1955 Fiscal Year. Sacramento, 1955.
159	California. Public Utilities Commission. Annual Report, 1955-1956 Fiscal Year. Sacramento, 1956.
160	California. Public Utilities Commission. Electric Power Survey, Years 1956-1960, for the State of California. San Francisco, October 15, 1957.
161	California. Public Utilities Commission. General Order No. 103: Rules Governing Water Service Including Minimum Standards for Design and Construction. Sacramento, 1957.
162	California. Public Utilities Commission. Rules Governing Filing and Posting of Tariff Schedules for Gas, Electric, Telephone, Telegraph, Water and Heat Utilities. General Order No. 96. Sacramento, n.d.
163	California. Public Utilities Commission. Uniform System of Accounts for Water Utilities (Class A, Class B and Class C). Sacramento, 1955.
164	California. Public Utilities Commission. Uniform System of Accounts for Water Utilities (Class D). Sacramento, 1954.
165	California. Public Utilities Commission. Water Utilities. San Francisco, 1958.
166	California. State Water Resources Board. Bulletin No. 1: Water Resources of California. Sacramento, 1951.
167	California. State Water Resources Board. Bulletin No. 2: Water Utilization and Requirements of California. 2 vols. Sacramento, June 1955.
168	California. State Water Resources Board. Bulletin No. 7: Santa Clara Valley Investigation. Sacramento, June 1955.
169	California. State Water Resources Board. Preview of the California Water Plan. Sacramento, March 1956.
170	California. State Water Rights Board. Annual Report of the State Water Rights Board of the State of California Covering Period July 5, 1956 to June 30, 1957. Sacramento, 1957.
171	California. State Water Rights Board. Annual Report of the State Water Rights Board to the Governor. January 1957.
172	California. State Water Rights Board. Rules, Regulations and Information Pertaining to Appropriation of Water in California. Sacramento, 1957.

Ref. No.

173 California. Water Code, 1955. Sacramento, n.d.

174 California. Water Project Authority. Bulletin No. 2: Feasibility of State Ownership and Operation of the Central Valley Project of California. Sacramento, March 1952.

175 California. Water Project Authority. Central Valley Project: Report on the Programming of Additional Electric Power Facilities to Provide for Absorption of Output of Shasta Power Plant in Northern California Market. Sacramento, February 1938.

176 California. Water Project Authority. Data and Information on the Central Valley Project and the Great Central Valley Basin of California. Sacramento, October 1941.

177 California. Water Project Authority. Preliminary Report to the California Legislature by the Water Project Authority of the State of California Relative to the Acquisition of the Central Valley Project by the State of California. Sacramento, May 19, 1953.

178 California. Water Project Authority. State Water Code Provisions Relating to Feather River Project and Central Valley Project. Sacramento, 1952.

United States Government Publications

179 U. S. Bureau of the Budget. Circular No. A-47: Reports and Budget Estimates Relating to Federal Programs and Projects for Conservation, Development, or Use of Water and Related Land Resources. Washington, 1952.

180 U. S. Bureau of the Census. U. S. Census of Agriculture: 1950. Vol. II, General Report, Chapter IV, Farm Labor and Farm Expenditures. Washington, 1952.

181 U. S. Bureau of the Census. U. S. Census of Agriculture: 1950. Vol. III, Irrigation of Agricultural Lands, Part 3, California. Washington, 1952.

182 U. S. Bureau of the Census. U. S. Census of Agriculture: 1954. Vol. I, Counties and State Economic Areas, Part 33, California. Washington, 1956.

183 U. S. Bureau of Reclamation. Annual Report 1956. Washington, 1956.

184 U. S. Bureau of Reclamation. Bureau of Reclamation Project Feasibilities and Authorizations. Washington, 1957.

185 U. S. Bureau of Reclamation. California Water. Washington, 1956. Pp. 13.

186 U. S. Bureau of Reclamation. Central Valley Basin, a Comprehensive Departmental Report on the Development of the Water and Related Resources of the Central Valley Basin, and Comments from the State of California and Federal Agencies. 81st Cong., 1st Sess., S. Doc. 113. Washington, 1949.

187 U. S. Bureau of Reclamation. Central Valley Project: Contract Between the United States and Corning Water District Providing for Water Service. Sacramento, 1957.

188 U. S. Bureau of Reclamation. Central Valley Project: Contract Between the United States and the Shafter-Wasco Irrigation District Providing for Water Service and for the Construction of a Distribution System. Contract No. 14-06-200-4032. Sacramento, February 11, 1955.

189 U. S. Bureau of Reclamation. Central Valley Project: Contract for the Furnishing of Water to the City of Orange Cove. Contract No. 14-06-200-5230. Sacramento, February 28, 1956.

190 U. S. Bureau of Reclamation. Central Valley Project Studies: Allocation of Costs, Problems 8-9. Washington, 1947.

191 U. S. Bureau of Reclamation. Central Valley Project Studies: Payments by Beneficiaries, Problems 10 to 13. Washington, 1947.

192 U. S. Bureau of Reclamation. Colorado-Big Thompson Project, Colorado: Contract Between the United States and the Northern Colorado Water Conservancy District Providing for the Construction of the Colorado-Big Thompson Project, Colorado. Reprint.

193 U. S. Bureau of Reclamation. The Columbia Basin Project. Washington, 1950. Pp. 26.

194 U. S. Bureau of Reclamation. Cumulative Supplement to the 1943 Edition of Federal Reclamation Laws, Annotated, 1946. Washington, 1947.

Ref. No.

195 U. S. Bureau of Reclamation. Evolution of Reclamation as a National Policy and Program as Implemented and Stimulated by Congressional and Other Investigations, Hearings and Surveys from 1878 to 1949. Washington, 1949. Pp. 22.

196 U. S. Bureau of Reclamation. An Experiment in the Measurement of the Indirect Benefits of Irrigation--Payette, Idaho, by M. E. Marts. Boise, Idaho, June 1950.

197 U. S. Bureau of Reclamation. Federal Reclamation Laws, Annotated, April 1943. Washington, 1943.

198 U. S. Bureau of Reclamation. 50 Years of Reclamation, Financial Report to the Nation's Stockholders, 1902-1952. Washington, 1952.

199 U. S. Bureau of Reclamation. "Irrigation Benefits," Manual, XIII, Part 2, Chapter 2.2, June 27, 1951. Pp. 8.

200 U. S. Bureau of Reclamation. Letter from E. G. Nielsen, Acting Commissioner, to Fred A. Seaton, Secretary of the Interior, July 18, 1956.

201 U. S. Bureau of Reclamation. 1956 Annual Report, Central Valley Project. Sacramento, 1957.

202 U. S. Bureau of Reclamation. Reclamation Accomplishments, Klamath Project, Oregon-California. Washington, February 1952.

203 U. S. Bureau of Reclamation. Repayment Review Statement. Sacramento, January 1, 1955.

204 U. S. Bureau of Reclamation. Report of Panel of Consultants on Secondary or Indirect Benefits of Water-Use Projects to M. W. Straus, Commissioner, by J. M. Clark, E. L. Grant, and M. M. Kelso. Washington, June 26, 1952.

205 U. S. Bureau of Reclamation. San Luis Unit, Central Valley Project, California: A Report on the Feasibility of Water Supply Development. Sacramento, May 1955.

206 U. S. Bureau of Reclamation. Second Supplement to the 1943 Edition of Federal Reclamation Laws, Annotated, 1952. Washington, 1952.

207 U. S. Bureau of Reclamation. "Statement of Policy Regarding Water Service--Irrigation Season 1957--Central Valley Project," Sacramento, February 6, 1957. Pp. 9.

208 U. S. Chamber of Commerce. National Water and Power Policy, a Digest of the Water Policy Conference, St. Louis, January 24-25, 1956. Washington, 1956.

209 U. S. Commission on Organization of the Executive Branch of the Government. Task Force Report on Public Works (Appendix Q): Department of Works, a Report with Recommendations, prepared by R. Moses. Washington, January 1949.

210 U. S. Commission on Organization of the Executive Branch of the Government. Task Force Report on Water Resources and Power. 3 vols. Washington, June 1955.

211 U. S. Commission on Organization of the Executive Branch of the Government. Task Force Report on Water Resources Projects (Appendix K): Certain Aspects of Power, Irrigation and Flood Control Projects, a Report with Recommendations, prepared by A. B. Roberts. Washington, January 1949.

212 U. S. Commission on Organization of the Executive Branch of the Government. Water Resources and Power, a Report to Congress. 2 vols. Washington, June 1955.

213 U. S. Comptroller General. Audit Report to the Congress of the United States: Central Valley Basin, Calif. Water Resources Development Program, Bureau of Reclamation, Dept. of the Interior and Corps of Engineers (Civil Functions), Dept. of the Army, for the Fiscal Year Ended June 30, 1956. Washington: General Accounting Office, 1957.

214 U. S. Congress. Fish and Wildlife Act of 1956. 84th Cong., 2d Sess., Public Law 1024. Washington, 1956.

215 U. S. Congress. January 1955 Economic Report of the President: Hearings before the Joint Committee on the Economic Report, Congress of the United States 84th Congress, 1st Session Pursuant to Sec. 5 (a) of Public Law 304 (79th Congress). Washington, 1955.

216 U. S. Congress, House. Central Valley Federal Reclamation Project. Letter from the Acting Secretary of the Interior. 80th Cong., 1st Sess., H. Doc. No. 146. Washington, 1947.

Ref. No.

217 U. S. Congress, House. Colorado River Storage Project: Hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, Part 2. 84th Cong., 1st Sess. Washington, March 1955.

218 U. S. Congress, House. House Resolution 6035. 85th Cong., 1st Sess. Washington, 1957.

219 U. S. Congress, House. Sale of Electric Power: Hearings before the Committee on Irrigation and Reclamation, Part I. 79th Cong., 2d Sess. Washington, January 1946.

220 U. S. Congress, House. San Luis Unit, Central Valley Project, California; Hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs on H. R. 10915 and H. R. 10952. 84th Cong., 2d Sess. Washington, May 1956.

221 U. S. Congress, House, Committee on Public Works. The Allocation of Costs of Federal Water Resource Development Projects. Report from the Subcommittee to Study Civil Works. 82d Cong., 2d Sess., H. Committee Print No. 23. Washington, December 5, 1952.

222 U. S. Congress, House, Committee on Public Works. The Civil Functions Program of the Corps of Engineers, United States Army. Report from the Subcommittee to Study Civil Works. 82d Cong., 2d Sess., H. Committee Print No. 21. Washington, December 5, 1952.

223 U. S. Congress, House, Committee on Public Works. Economic Evaluation of Federal Water Resource Development Projects. Report from the Subcommittee to Study Civil Works. 82d Cong., 2d Sess., H. Committee Print No. 24. Washington, December 5, 1952.

224 U. S. Congress, House, Committee on Public Works. The Flood Control Program of the Department of Agriculture. Report from the Subcommittee to Study Civil Works. 82d Cong., 2d Sess., H. Committee Print No. 22. Washington, December 5, 1952.

225 U. S. Congress, Senate. San Luis (California) Irrigation Development; Hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs on S. 178 (San Luis Portion). 84th Cong., 2d Sess. Washington, May 1956.

226 U. S. Congress, Senate. Senate Bill 1887. 85th Cong., 1st Sess. Washington, 1957.

227 U. S. Congress, Senate. Senate Resolution 281. 84th Cong., 2d Sess. Washington, 1956.

228 U. S. Department of Agriculture. The Yearbook of Agriculture, 1955: Water. Washington, n. d.

229 U. S. Department of Agriculture, Soil Conservation Service. The Watershed Protection and Flood Prevention Act: A New Tool for Soil and Water Conservation. Washington, September 1955.

230 U. S. Department of the Interior. Estimated Use of Water in the United States, 1955. (Geological Survey Circular 398.) Washington, 1957.

231 U. S. Department of the Interior. Letter from Roger C. Ernst, Assistant Secretary of the Interior, to Hon. Clair Engle, Chairman House Committee on Interior and Insular Affairs, June 28, 1957.

232 U. S. Department of the Interior. Letter from Fred A. Seaton, Secretary of the Interior, to The President, August 1, 1956.

233 U. S. Department of the Interior. 1956 Annual Report: The Conservation of Natural Resources. Washington, 1956.

234 U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs. Proposed Practices for Economic Analysis of River Basin Projects. Washington, 1950.

235 U. S. Library of Congress, Legislative Reference Service. Public Affairs Abstracts, II, No. 3. Washington, March 1951.

236 U. S. Library of Congress, Legislative Reference Service. Public Affairs Bulletin No. 76: Natural Resources Activity of the Federal Government, Historical, Descriptive, Analytical. Washington, 1950.

237 U. S. Presidential Advisory Committee on Water Resources Policy. Water Resources Policy, December 22, 1955. Washington, 1956. (Also published as H. Doc. No. 315, 84th Cong., 2d Sess.)

238 U. S. President's Materials Policy Commission. Resources for Freedom. 5 vols. Washington, June 1952.

Ref. No.

239 U. S. President's Water Resources Policy Commission. The Report of the President's Water Resources Policy Commission. Vol. 1: A Water Policy for the American People. Vol. 2: Ten Rivers in America's Future. Vol. 3: Water Resources Law. Washington, 1950.

240 U. S. President's Water Resources Policy Commission. A Water Policy for the American People, Summary of Recommendations. Washington, December 1950.

241 U. S. Southwestern Power Administration. A History of SPA. Tulsa, Oklahoma, April 1, 1952.

Articles

242 Aandahl, A. R., W. G. Murray, and W. Scholtes. "Economic Rating of Soils for Tax Assessment," Journal of Farm Economics, XXXVI (August 1954), 483-99.

243 Aandahl, F. G. "The Nation's Water Resources," Journal American Water Works Association, XLVIII (August 1956), 931-41.

244 "Aid to Water Plan," Electrical World, CXLVII (January 14, 1957), 51.

245 Alexander, L. J. "State Water Resources Legislation in 1955: Pacific Coast States," Journal American Water Works Association, XLVII (September 1955), 856-57.

246 American Society of Civil Engineers, et al. "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works," Ohio State Law Journal, XII (Spring 1951), 151-276.

247 Angel, A. D. "Who Will Pay for the Central Valley Project of California," Journal of Land & Public Utility Economics, XXII (August 1946), 266-72.

248 Ayres, L. E. "Basic Considerations in Determining Water Rates," Journal American Water Works Association, XLII (November 1950), 981-1002.

249 Barlowe, R. "Recent Land-Grant College Research on the Economics and Policy Aspects of Water Use," Farm Foundation: Increasing Understanding of Public Problems and Policies, 1955, 66-74.

250 Barr, G. W. "Discussion: 'Acreage Limitation in Federal Irrigation Projects with Particular Reference to the Central Valley Project of California,' by V. Fuller," Journal of Farm Economics, XXXI (November 1949), 982-83.

251 "Basin Compacts," Engineering News-Record, CLVIII (May 16, 1957), 24.

252 Bennett, N. B., Jr. "Cost Allocation for Multi-Purpose Water Projects," Journal of the Irrigation and Drainage Division of the American Society of Civil Engineers, LXXXII, IR 2 (May 1956), Paper 961.

253 Bennett, N. B., Jr. "Discussion: 'Cost-Allocation for Multi-Purpose Projects,' by N. B. Bennett, Jr.," Journal of the Irrigation and Drainage Division of the American Society of Civil Engineers, LXXXIII, IR 1 (May 1957), Paper 1257.

254 Berry, W. L. "The California Water Plan," Journal American Water Works Association, XLII (April 1950), 381-85.

255 Blaney, H. F. "Use of Water by Irrigated Crops in California," Journal American Water Works Association, XLIII (March 1951), 189-200.

256 Bonbright, J. C. "Two Partly Conflicting Standards of Reasonable Public Utility Rates." American Economic Review, XLVII (May 1957), 386-93.

257 Bowman, J. S. "Trend Toward Multipurpose Developments," Civil Engineering, XXII (September 1952), 736-39.

258 Bredo, W. "A Framework for Water Pricing Policy," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 63-70.

259 Breimyer, H. F. "Sources of Our Increasing Food Supply," Journal of Farm Economics, XXXVI (May 1954), 228-42.

260 Brough, O. L., Jr. "Economic Problems of the Individual Farmer and His Family Engaged in Irrigation Agriculture," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development; Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 117-28.

Ref. No.

261 Brownlee, O. H. and W. W. Heller. "Highway Development and Financing," American Economic Review, XLVI (May 1956) 232-50.

262 "California Unwraps Its Big Water Plan," Engineering News-Record, CLVI (May 17, 1956), 27-28.

263 "The California Water Plan and Its Administration," papers from a panel discussion presented on Oct. 25, 1956, at the Calif. Section Meeting, San Diego, Calif., Journal American Water Works Association, XLIX (February 1957), 89-147.

264 Chase, R. W. "California Ground Water Replenishment Bill," Journal American Water Works Association, XLVII (April 1955), 383-88.

265 Ciriacy-Wantrup, S. V. "Benefit-Cost Analysis and Public Resource Development," Journal of Farm Economics, XXXVII (November 1955), 676-89.

266 Ciriacy-Wantrup, S. V. "Capital Returns from Soil-Conservation Practices," Journal of Farm Economics, XXIX (November 1947), 1181-96.

267 Ciriacy-Wantrup, S. V. "Concepts Used as Economic Criteria for a System of Water Rights," Land Economics, XXXII (November 1956), 295-312.

268 Ciriacy-Wantrup, S. V. "Cost Allocation in Relation to Western Water Policies," Journal of Farm Economics, XXXVI (February 1954), 108-29.

269 Ciriacy-Wantrup, S. V. "Economic Analysis of Water Resource Policies," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 21-40

270 Ciriacy-Wantrup, S. V. "Economics of Joint Costs in Agriculture," Journal of Farm Economics, XXIII (November 1941), 771-818.

271 Ciriacy-Wantrup, S. V. "Policy Considerations in Farm Management Research in the Decade Ahead," Journal of Farm Economics, XXXVIII (December 1956), 1301-11.

272 Ciriacy-Wantrup, S. V. "Problems in the Use of the Public District for Ground-Water Management," Land Economics, XXXII (August 1956), 260-69.

273 Ciriacy-Wantrup, S. V. "Resource Conservation and Economic Stability," Quarterly Journal of Economics, LX (May 1946), 412-52.

274 Ciriacy-Wantrup, S. V. "The Role of Benefit-Cost Analysis in Public Resource Development," Western Agricultural Economics Research Council, Committee of the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 3. Berkeley, 1954, 17-28.

275 Ciriacy-Wantrup, S. V. "Some Economic Issues in Water Rights," Journal of Farm Economics, XXXVII (December 1955), 875-85.

276 Ciriacy-Wantrup, S. V. "Taxation and the Conservation of Resources," Quarterly Journal of Economics, LVIII (February 1944), 157-95.

277 Clyde, G. D. "Water Resources, Their Development and Utilization from a National Point of View," Journal of American Society of Farm Managers and Rural Appraisers, XIX (April 1955), 59-69.

278 "The Colorado River Aqueduct Number," Engineering News-Record, CXXI, No. 21 (November 24, 1938).

279 Commonwealth Club of California. "Who Should Develop Calinia's Water Resources for Water and Power?" Transactions, XLIV, No. 5 (March 13, 1950).

280 "Considerations in Recreational Use of Impounding Reservoirs," papers from a panel discussion presented on May 7, 1956, at the Diamond Jubilee Conference, St. Louis, Mo., Journal American Water Works Association, XLVIII (November 1956), 1403-12.

281 Crecink, J. C. "Relationship of Future Water Resources Development to the Economic Development of the West (Economic Considerations)," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 81-84.

Ref. No.

282 DeHaven, J. C. and J. Hirshleifer. "Feather River Water: A Rejoinder," Land Economics, XXXIII (November 1957), 359-60.

283 DeHaven, J. C. and J. Hirshleifer. "Feather River Water for Southern California," Land Economics, XXXIII (August 1957), 198-209.

284 Dexheimer, W. A. "Multiple-purpose River Basin Development by USBR," Civil Engineering, XXVI (December 1956), 814-18.

285 Diemer, R. B. "Colorado River Aqueduct Capacity Being Doubled to Fill Needs Until 1980," Civil Engineering, XXVI (December 1956), 820-23.

286 Diemer, R. B. "Expansion of the Colorado River Aqueduct System," Journal American Water Works Association, XLV (April 1953), 397-404.

287 Diemer, R. B. "Metropolitan Water District of Southern California," Journal American Water Works Association, XLVI (August 1954), 793-95.

288 Drake, L. S. "A Method of Showing Farmers How to Estimate Gross Income and Marginal Value Products," Journal of Farm Economics, XXXVI (February 1954), 66-77.

289 "Early Start for Feather River Job," Engineering News-Record, CLVII (November 8, 1956), 26.

290 Ely, O. "Public Power Developments and the Preference Clause," Public Utilities Fortnightly, LVII (January 19, 1956), 104-09.

291 Engelbert, E. A. "The Functions of Government in Water Resources Development," Proceedings of the Western Farm Economics Association, 25th Annual Meeting (July 1952), 60-63.

292 Engelbert, E. A. "Political Aspects of Future Water Resources Development in the West," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 85-95.

293 Engineers Joint Council. "National Water Policy, a Committee Report," Journal American Water Works Association, XLIII (January 1951), 24-30.

294 "Erosion of the Preference Clause," Pacific Northwest Public Power Bulletin, VII (October 1953), 2.

295 "Feather River Project Report Summarized," Western Water News, VII (May 1955), 3-6.

296 "Federal-State-Local Units Set Water Resources Policy," Public Health Reports, LXXII (March 1957), 246-47.

297 "Federal-State Relations and Rights to Water," Western Water News, VII (February 1955), 4-6.

298 Ferrier, H. W. "Administration of Water Rights in California," California Law Review, XLIV (December 1956).

299 Fogarty, E. R. "Benefits of Water Development Projects," Journal of the Irrigation and Drainage Division of the American Society of Civil Engineers, LXXXII, IR 2 (May 1956), Paper 981.

300 Folz, W. E. "The Economics of the Control and Use of Water," Journal of Farm Economics, XXXVII (December 1955), 866-903.

301 Folz, W. E. "The Economics of Water Resources Development," Proceedings of the Western Farm Economics Association, 25th Annual Meeting (July 1952), 52-55.

302 Folz, W. E. "The Role of Benefit-Cost Analysis in Public Resource and Current Concepts and Practices of Benefit-Cost Analysis for Federal Agencies and Private Business in Natural Resource Development (Discussion of papers by S. V. Ciriacy-Wantrup and M. M. Regan and J. F. Timmons)," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 3. Berkeley, 1954, 29-34.

303 Fuhriman, W. U. "Federal Aid to Irrigation Development," Journal of Farm Economics, XXXI (November 1949), 965-75.

304 Fuller, V. "Acreage Limitation in Federal Irrigation Projects with Particular Reference to the Central Valley Project of California," Journal of Farm Economics, XXXI (November 1949), 976-82.

Ref. No.

305 Gertel, K. "Recent Suggestions for Cost Allocation of Multiple-Purpose Projects in the Light of Public Interest," Journal of Farm Economics, XXXIII (February 1951), 130-34.

306 Glaeser, M. G. "A Critique of Public Power Policies," American Economic Review, XLVII (May 1957), 394-402.

307 Glaeser, M. G. "A Water Policy for the American People: A Commentary," Land Economics, XXVII (May 1951), 169-72.

308 Goslin, I. V. "Repayment Plan for Multipurpose Reservoirs," Engineering News-Record, CLVII (September 20, 1956), 53-56.

309 Gramm, W. S. "Economics and Politics: Inseparables in Water Resource Development," Proceedings of the Thirty-First Annual Conference of the Western Economic Association, Los Angeles, August 30-31, 1956, 26-30; Discussion 30-31.

310 Grant, E. L. "The Role of Benefit-Cost Analysis in Public Resources Development (Discussion of S. V. Ciriacy-Wantrup's Paper)," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 3. Berkeley, 1954, 35.

311 Greenshields, E. L. "Discussion: 'Some Economic Issues in Water Rights,' by Ciriacy-Wantrup," Journal of Farm Economics, XXXVII (December 1955), 899-901.

312 Griffith, C. A. "Development of the California Water Plan," Journal American Water Works Association, XLVII (April 1955), 367-73.

313 Gulick, L. "'Authorities' and How to Use Them," The Tax Review, VIII (November 1947), 47-52.

314 Hamman, C. L. "Water Policy and Western Industrial Development," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 75-80.

315 Hampson, C. C. "Development of the Colorado River Basin," Proceedings of the Western Farm Economics Association, 25th Annual Meeting (July 1952), 56-59.

316 Holsinger, H. "Some Legal Aspects of Ground Water and the California Water Plan," Journal American Water Works Association, XLVII (April 1955), 374-82.

317 Homan, P. T. "Economics Aspects of the Boulder Dam Project," The Quarterly Journal of Economics, XLV (February 1931), 177-217.

318 Horner, W. W. "Government Action or Private Enterprise in River Valley Development; a Desirable National Water Policy," American Economic Review, XLI (May 1951), 280-88.

319 Hotes, F. L., et al. "Discussion: 'Cost-Allocation For Multi-Purpose Projects,' by N. B. Bennett, Jr.," Journal of the Irrigation and Drainage Division of the American Society of Civil Engineers, LXXXII, IR 3 (November 1956), Paper 1111-21, 1123, 1126.

320 Huffman, R. E. "A Framework for Water Pricing Policy (A Discussion of Dr. Bredo's Paper)," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 71-74.

321 Huffman, R. E. "Public Water Policy for the West," Journal of Farm Economics, XXXV (December 1953), 719-27.

322 Huffman, R. E. "The Water Resource Problem," Farm Foundation: Increasing Understanding of Public Problems and Policies, 1955, 35-44.

323 Hurlbut, W. W. "Water Requirements and Sources of Supply for California," Western City, XXVII (October 1951), 29-42.

324 Hutchins, W. A. "The Development and Present Status of Water Rights and Water Policy in the United States," Journal of Farm Economics, XXXVII (December 1955), 866-74.

325 Hutchins, W. A. "Irrigation Water Rights," Supplement to Western Water News, January 1956 Issue. Pp. 4.

326 Hutchison, S. B. "Fitting Big Dams into Little Economies," Land Economics, XXX (November 1954), 329-32.

Ref. No.

327 Hyatt, E. "Water Development Plans in California," Journal American Water Works Association, XXXIX (May 1947), 430-42.

328 Joss, A. "Repayment Experience on Federal Reclamation Projects," Journal of Farm Economics, XXVII (February 1945), 153-67.

329 Kelso, M. M. "Evaluation of Secondary Benefits of Water-Use Projects," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 49-62.

330 Koch, M. M. "Instead of Federal Power Preference, Spread the Benefits Equally," Electrical West, CXII (June 1954), 80-82.

331 Landstrom, K. S. "Reclamation Under the Desert-Land Act," Journal of Farm Economics, XXXVI (August 1954), 500-08.

332 Lee, J. K. "Economic Analysis of Water Resource Policies (Comments on Dr. Wantrup's Paper)," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 41-49.

333 Lee, J. K. "Irrigation Policy for Arid Lands," Journal of Farm Economics, XXXIV (December 1952), 751-55.

334 Lee, J. K. and G. G. Stamm. "The Economic Problems of Irrigation Development in Need of Research by Agricultural Economists," Proceedings of the Western Farm Economics Association, 23rd Annual Meeting (June 1950), 101-07.

335 Longwell, J. S. "Water Works Management and Administration in California," Journal American Water Works Association, XXXVI (November 1944), 1224-29.

336 McKean, R. N. "Criteria for the Selection of Water-Resource Projects," Operations Research, IV (February 1956), 52-60.

337 Maffitt, D. L., A. G. Matthews, and F. Merryfield. "Discussion of National Water Policy," Journal American Water Works Association, XLIII (June 1951), 414-22.

338 Margolis, J. "Secondary Benefits, External Economics, and the Justification of Public Investment," The Review of Economics and Statistics, XXXIX (August 1957), 284-91.

339 Marquis, R. H., R. M. Freeman, and M. S. Heath, Jr. "The Movement for New Water Rights Laws in the Tennessee Valley States," Tennessee Law Review, XXIII (April 1955), 797-837.

340 Matthew, R. "Use of Colorado River Water in California," Proceedings of the American Society of Civil Engineers, LXXIX (November 1953), Separate No. 347.

341 Merryfield, F. "Water Supply Progress in 1956," Water & Sewage Works, CIV (January 1957), 1-13.

342 Milliman, J. W. "Commonality, the Price System, and Use of Water Supplies," Southern Economic Journal, XXII (April 1956), 426-37.

343 Morris, S. B. "The Colorado River - The Southwest's Greatest Natural Resource," Journal American Water Works Association, XXXIX (October 1947), 945-67.

344 Morris, S. B. "National Water Resources Policy Recommendations," Journal American Water Works Association, XLIV (April 1952), 287-301.

345 Morris, S. B. "Review of the Report of the President's Water Resources Policy Commission," Journal American Water Works Association, XLIII (June 1951), 391-400.

346 Morris, S. B. "Water Works Management and Los Angeles Progress," Journal American Water Works Association, XLII (July 1950), 654-64.

347 National Reclamation Association. "Report of the Power Rate Study Committee," Proceedings of the 24th Annual Meeting of the National Reclamation Association at Lincoln, Nebraska, October 24-26, 1955. Washington, 1955, 154-57.

348 National Reclamation Association. "Report of the Repayment Study Committee," Proceedings of the 24th Annual Meeting of the National Reclamation Association at Lincoln, Nebraska, October 24-26, 1955. Washington, 1955, 157-63.

Ref. No.	
349	National Reclamation Association. "Report of the Small Projects Committee," Proceedings of the 24th Annual Meeting of the National Reclamation Association at Lincoln, Nebraska, October 24-26, 1955. Washington, 1955, 163-166.
350	National Reclamation Association. "Report of the Water Policy Committee Pertaining to the Hoover Commission Recommendations on Water Resources and Power," Proceedings of the 24th Annual Meeting of the National Reclamation Association at Lincoln, Nebraska, October 24-26, 1955. Washington, 1955.
351	Neuner, E., Jr. "Commentary: On 'Feather River Water for Southern California'," Land Economics, XXXIII (August 1957), 210-12.
352	Neuner, E., Jr. "Economics of the Proposed Feather River Project," Proceedings of the Thirty-First Annual Conference of the Western Economic Association, Los Angeles, August 30-31, 1956, 20-25.
353	Penn, R. J. "A Water Policy for the American People: A Commentary," Land Economics, XXVII (February 1951), 76-79.
354	Pirnie, M. "Objectives of a National Water Policy," Journal American Water Works Association, XLIII (June 1951), 409-13.
355	"Principles of a Sound National Water Policy--A Restatement," Civil Engineering, XXVII (May 1957), 52-57.
356	Rasmussen, J. J. "Economic Criteria for Water Development Projects," Journal of the Irrigation and Drainage Division of the American Society of Civil Engineers, LXXXII, IR 2 (May 1956), Paper 977.
357	Ratchford, B. U. "Government Action or Private Enterprise in River Valley Development: An Economist's View," American Economic Review, XLI (May 1951), 299-306.
358	Raver, P. J. "Government Action and Private Enterprise in River Valley Development: A Public Administrator's View," American Economic Review, XLI (May 1951), 289-98.
359	Regan, M. M. and E. L. Greenshields. "Benefit-Cost Analysis of Resource Development Programs," Journal of Farm Economics, XXXIII (November 1951), 866-78.
360	Regan, M. M. and J. F. Timmons. "Current Concepts and Practices in Benefit-Cost Analysis of Natural Resource Developments," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 3. Berkeley, 1954, 1-15.
361	Renshaw, E. "A Note on the Measurement of the Benefits from Public Investment in Navigation Projects," The American Economic Review, XLVII (September 1957), 652-62.
362	Selby, H. E. "Factors Affecting Value of Land and Water in Irrigated Land," Journal of Land and Public Utility Economics, XXI (August 1945), 250-58.
363	Selby, H. E. "The Importance of Irrigation in the Economy of the West," Journal of Farm Economics, XXXI (November 1949), 955-64.
364	Selby, H. E. "Indirect Benefits from Irrigation Development," Journal of Land and Public Utility Economics, XX (February 1944), 45-51.
365	Selby, H. E. "A Method of Determining Feasible Irrigation Payments," Journal of Farm Economics, XXIV (August 1942), 637-46.
366	Seymour, W. "The Partnership Policy in Regional Power Planning," American Economic Review, XLVI (May 1956), 521-31.
367	Shelton, M. J. "Need for Planning in Utilizing Water Resources," Journal American Water Works Association, XLIX (August 1957), 993-1000.
368	Smith, S. C. "Problems in the Use of the Public District for Ground-Water Management," Land Economics, XXXII (August 1956), 259-69.
369	Smith, S. C. "The Role of the Public District in the Integrated Management of Ground and Surface Water," Western Agricultural Economics Research Council and Western Regional Research Committee W-42, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 5. Berkeley, 1956, 81-91.
370	Snow, R. V. "Project Repayment Contracts--Custom Tailored," Reclamation Era, XXXIV (November 1948), 217-18.
371	Snyder, J. H. "On the Economics of Ground-Water Mining--A Case Study in an Arid Area," Journal of Farm Economics, XXXVI (November 1954), 600-10.
372	"A Sound National Water Policy," Electrical World, CXLVII (April 15, 1957), 69-72.
373	"State Legislature Passes Bill to Establish a Central Water Agency for California," Engineering News-Record, CLVI (April 19, 1956), 29.
374	Steele, H. A. "Economics of Small Watershed Development," Agricultural Economics Research, VIII (January 1956), 17-23.
375	Steele, H. A. and W. A. Green. "'A Statement of Desirable Policy with Respect to the Conservation, Development, and Use of the National Water Resources': A Digest and Commentary," Land Economics, XXVII (August 1951), 252-56.
376	Steele, H. A. and M. M. Regan. "Organization and Administrative Arrangements for an Effective Water Policy," Journal of Farm Economics, XXXVII (December 1955), 886-96.
377	Stewart, C. E. "Public Problems of Irrigation Development in the West," Western Agricultural Economics Research Council, Committee on the Economics of Water Resources Development: Water Resources and Economic Development of the West, Report No. 1. Berkeley, 1953, 107-16.
378	Stone, A. W. "The Hoover Reports on Water Resources and Power--A Commentary," California Law Review, XLIII (December 1955), 747-65.
379	Sullivan, G. L. "The California Water Plan," Mechanical Engineering, LXXIX (September 1957), 858-60.
380	Taylor, M. C. "Considerations for Reclamation Policy," Land Economics, XXVII (February 1951), 31-40.
381	Taylor, P. S. "The Excess Land Law: Execution of a Public Policy," Yale Law Journal, LXIV (February 1955), 477-514.
382	Taylor, P. S. "The 160-Acre Water Limitation and the Water Resources Commission," The Western Political Quarterly, III (September 1950), 435-50.
383	Timmons, J. F. "Economic Framework for Watershed Development," Journal of Farm Economics, XXXVI (December 1954), 1170-83.
384	"Two New Water Policy Statements Issued," Engineering News-Record, CLVIII (May 2, 1957), 25.
385	Voelker, S. W. and J. Muehlbeier, "Institutional Arrangements for Watershed Programs," Journal of Farm Economics, XXXVI (December 1954), 1184-96.
386	"Water for 40,000,000 People," Electrical West, CXVII (August 1956), 75-79.
387	"Water Policy," Farm Policy Forum, VIII (Fall 1955), 1-36.
388	Wertheimer, R. "President's Water Resources Policy Commission Report: Water Resources Law," California Law Review, XXXIX (June 1951), 322-27.
389	White, G. F. "The Limit of Economic Justification for Flood Protection," The Journal of Land and Public Utility Economics, XII (May 1936), 133-48.
390	Wolman, A. "Basic Principles of a National Water Resources Policy, Committee Report," Journal American Water Works Association, XLIX (July 1957), 825-33.
391	Wolman, A. "Long-Range Planning for Water Service," Journal American Water Works Association, XLVIII (December 1956), 1457-62.
392	Wolman, A. "Water Policy as the Engineers See It," Journal American Water Works Association, XLIII (June 1951), 401-08.

Speeches

Ref. No.	
393	Aandahl, F. G. "Water for Food and Fiber," presented before the National Reclamation Association, Phoenix, November 8, 1957. Pp. 5.
394	Banks, H. O. "The California Water Plan," presented before the California Water Conference of the California State Chamber of Commerce, Los Angeles, February 23, 1956. Pp. 28.
395	Banks, H. O. "The California Water Plan--Public Reaction," presented before the Natural Resources Section, California State Chamber of Commerce, San Francisco, November 30, 1956. Pp. 17.
396	Banks, H. O. "Can Water Become a Non-Limiting Resource?" presented by M. J. Shelton before the Soil Conservation Society of America, Asilomar, August 30, 1957. Pp. 18.
397	Banks, H. O. "Facts of California Water Development," presented before the League of California Cities, San Francisco, September 25, 1957. Pp. 22.
398	Banks, H. O. "Legislative Action in 1957, a Must for California's Water Future," presented at convention of California Irrigation Districts Association, San Jose, December 13, 1956. Pp. 19.
399	Banks, H. O. "Northern California's State in the California Water Plan," presented before the Northern California Supervisors Association, Redding, California, December 14, 1956. Pp. 16.
400	Banks, H. O. Remarks presented before the California Supervisors Association, Santa Barbara, June 21, 1957. Pp. 13.
401	Banks, H. O. "Reorganization of the California Department of Water Resources," presented before the Pacific Southwest Inter-Agency Committee, San Francisco, June 19, 1957. Pp. 13.
402	Banks, H. O. "Statement on Present Status of Saline Water Conversion in Relation to California's Water Problems before the Atomic Energy Subcommittee of the Assembly Committee on Conservation, Planning and Public Works," Los Angeles, November 14, 1957.
403	Banks, H. O. "Statement Regarding Financing Aspects of State Water Resources Developments to the Subcommittee on Financial and Economic Policy for State Water Projects of the Joint Committee on Water Problems," presented by M. J. Shelton, San Francisco, October 24, 1957. Pp. 6.
404	Banks, H. O. "Statement to the Subcommittee on Financial and Economic Policy for State Water Projects of the Joint Committee on Water Problems," August 26 and 27, 1957.
405	Banks, H. O. "Statement to the Subcommittee on Financial and Economic Policy for State Water Projects of the Joint Committee on Water Problems," Sacramento, September 18, 1957. Pp. 13.
406	Banks, H. O. "The Urgency of Statewide Water Development," abstract of remarks presented before Natural Resources Committee, California State Chamber of Commerce, San Francisco, August 15, 1957.
407	Banks, H. O. "Who Will Have the Water?" presented at the Association of Western State Engineers, Seattle, August 21-23, 1957. Pp. 16.
408	Banks, H. O. and N. D. Sturm. "Some Economic Problems Confronting California's Department of Water Resources," presented by M. J. Shelton before the Conference on the Economics of California's Water Development, Lake Arrowhead, August 13, 1957. Pp. 21.
409	Berry, W. L. "General Aspects of the California Water Plan," presented before the Pacific Southwest Inter-Agency Committee, San Francisco, June 19, 1957. Pp. 25.
410	Bookman, M. "Financing and Constructing the Feather River Project," presented at meeting in Riverside, California, March 4, 1955.
411	Chilson, H. "Water Development Policies," presented before Annual Convention of the National Reclamation Association, Phoenix, November 7, 1957. Pp. 7.
412	Cobey, J. A. "The Areas of Origin Problem," presented before California Water Conference called by California State Chamber of Commerce, Fresno, February 20, 1957. Pp. 6.
413	Davis, C. A. "Our National Water Resources Policy," presented at Annual Conference of American Water Works Association, Chicago, June 13, 1955.
414	Dominy, F. E. "Financing and Repayment of Water Projects," presented before Conference on Economics of California's Water Development, Lake Arrowhead, August 13, 1957. Pp. 15.
415	Dominy, F. E. "Financing and Repayment of Water Projects," presented before Wyoming Development Association, Thermopolis, Wyoming, October 7, 1957. Pp. 9.
416	Dunham, Col. L. E., Jr. "Are We Prepared for Another Major Flood?" presented before the Water Resources Committee, California State Chamber of Commerce, Los Angeles, December 6, 1957.
417	Edmonston, A. D. "California's Water Plan," presented before the Northern California Agriculture-Business Conference, San Francisco, April 22, 1955. Pp. 16.
418	Edmonston, A. D. "The Feather River Project," presented to the San Francisco Sections of the American Institute of Electrical Engineers and American Society of Civil Engineers, May 10, 1955. Pp. 22.
419	"Federal Participation in Water Financing Urged by Congressman Clair Engle," summary of address by Engle on subject 'New Federal-State Relations in Water Development,' <u>Town Hall</u>, XIX (November 26, 1957), 2-4.
420	Griffith, E. J. "Summary of Remarks," presented before Water Problems Department, Kern County Farm Bureau, Bakersfield, June 20, 1957.
421	Haley, J. M. "The California Water Plan," presented to the Farm and Home Conference at the University of California, Davis, January 26, 1956. Pp. 18.
422	Henley, A. T. "The Evolution of Forms of Water Users Organizations in California," presented before Conference on Legal Problems in Water Resources sponsored by School of Law, University of California, Berkeley, May 16, 1957. Pp. 16.
423	Holsinger, H. "Water Reservations for Counties and Areas of Origin," presented at a meeting of the Water Problems Section of the Commonwealth Club of California, March 24, 1955. Pp. 14.
424	Houston, N. T. "A Research Approach to Water Project Planning," presented at California Section, American Water Works Association, San Diego, October 26, 1956.
425	Hughes, W. F. "Economic Considerations in Irrigation," presented before the Irrigation Service and Supplies Short Course, February 11-12, 1954, at College Station, Texas. Washington: U. S. Agricultural Research Service, Production Economics Research Branch, 1954. Pp. 5.
426	Hyatt, E. "History and Development of Water in California," presented before Water Resources Section, California State Chamber of Commerce, Los Angeles, December 2, 1949. Pp. 14.
427	Jensen, J. "The Importance of Water to Industry in Southern California," presented at the Annual Meeting of the Petroleum Division of the American Society of Mechanical Engineers, Los Angeles, September 28, 1954.
428	Jensen, J. "Industry and Water in Southern California," September 21, 1955. Pp. 10.
429	Jensen, J. "State Water Projects Statement," presented at a meeting of Statewide Water Resources Committee, California State Chamber of Commerce, San Francisco, August 15, 1957. Pp. 7.
430	Jensen, J. "Statement before the Joint Interim Committee on Water Resources Development Problems," Los Angeles, November 19, 1957. Pp. 8.
431	Jensen, J. "Statement before the Joint Subcommittee on Financial and Economic Policy for State Water Projects," Los Angeles, November 13, 1957.
432	Johnson, A. R. "Evaluating the Effects of Water Projects," presented at the Conference on Economics of California's Water Development, Lake Arrowhead, California, August 13, 1957.
433	Kennedy, H. W. "An Appraisal of Latest Developments in the Solution of California Water Problems," outline of points presented to the Statewide California Water Conference, Los Angeles, February 24, 1956.
434	Kennedy, H. W. "Where Are We Now in the Attempted Solution of California's Water Problem?" presented before the Statewide Water Resources Committee of the California State Chamber of Commerce, San Francisco, August 15, 1957. Pp. 6.

Ref. No.	
435	Lincoln, L. H. "Prospects for Agreement on Distribution of California's Water Resources," presented before California State Chamber of Commerce, Water Resources Section, Los Angeles, December 6, 1957.
436	McClain, R. B. "Statement of Chairman of Committee for Semitropic Water Storage District before the Director of Water Resources and Members of the State Water Board of the State of California," Bakersfield, September 25, 1956. Pp. 3.
437	McMartin, W. "The Economics of Land Classification," presented before the Conference of Regional and District Economics, Billings, Montana, April 12, 1950. Pp. 12.
438	Miller, L. A. Remarks before the National Conference on Water Resources Policy, St. Louis, January 24, 1956.
439	Milliman, J. W. "Economic Problems of the Metropolitan Water District of Southern California," presented to Western Economic Association, Salt Lake City, August 29, 1957.
440	Milliman, J. W. "An Economist Looks at State Water Planning," presented to the Water and Power Committee, Los Angeles Chamber of Commerce, November 1, 1957.
441	Morris, S. B. "The Feather River Project and the California Water Plan," Los Angeles, September 19, 1956. Pp. 18.
442	Morris, S. B. "Financing and Repayment of the Feather River Project," presented at meeting of the Feather River Project Association, Los Angeles, December 14, 1956. Pp. 13.
443	Regan, E. J. "The Delta--The Key to California's Water Problems," presented before the Statewide Water Resources Committee, California State Chamber of Commerce, San Francisco, August 15, 1957.
444	Shelton, M. J. "The California Water Plan," presented before League of California Cities, 58th Annual League Conference, Los Angeles, October 31, 1956. Pp. 14.
445	Shelton, M. J. "California's Water Program as It Affects You," presented before the Dairy Institute of California, Santa Barbara, November 29, 1956. Pp. 15.
446	Shelton, M. J. "Recreational Considerations in the California Water Plan," presented at Conference on Recreational Use of Impounded Water, Richmond, California, December 13, 1956. Pp. 14.
447	Shelton, M. J. "Water Resources and Problems of California," presented before California State Junior Chamber of Commerce, Sacramento, August 17, 1957. Pp. 13.
448	Shelton, M. J. and F. J. Groat. "Power for the Future in the California Water Plan," presented by M. J. Shelton before the Power Division, American Society of Civil Engineers, San Francisco Section, November 20, 1956. Pp. 16.
449	Smith, B. L., C. Kaupke, and C. H. Smith. "The Kings River Contract," discussion presented before the Statewide Water Resources Committee, California State Chamber of Commerce, San Francisco, August 15, 1957.
450	Smith, S. C. "Research in the Economics of Water," prepared for the Conference on Water Resources Research at the University of California, Los Angeles, June 28, 1957. Pp. 16.
451	Straus, M. W. "Water in Our World," presented before the Denver Rotary Club on occasion of dedication of Reclamation Engineering Center, Denver, July 20, 1950. Pp. 8.
452	Wente, C. F. "Financing Statewide Water Development," summary, presented before Statewide Water Resources Committee, California State Chamber of Commerce, San Francisco, August 15, 1957.
453	Wiley, H. R. "Some Suggestions in Connection with the California Water Plan and the Feather River Project," presented before Water and Power Committee, Los Angeles Chamber of Commerce, August 10, 1957.
454	Wood, S. E. "Water Allocation and Social Institutions," presented at the University of California Conference on the Economics of California's Water Development at Lake Arrowhead, August 12, 1957.

Miscellaneous References

Ref. No.	
455	Ablin, R. "The Problem of Cost Allocation in Multiple-Purpose Water Use Projects." (Natural Resources Paper No. 11.) University of Chicago Office of Agricultural Economics Research, Paper No. 5605, January 25, 1956.
456	Allen, J. F. "California's Growth Depends on Solving Distribution of Water," reprinted from San Francisco Examiner, April 7, 1957, by Feather River Project Association, Los Angeles.
457	Bottorff, A. "Concept for Timely Development of the State Authorized Feather River Project and the Proposed Federal San Luis Unit of the Central Valley Project," second draft of paper, August 19, 1957. Pp. 6.
458	California Agriculture.
459	California, Magazine of the Pacific.
460	California State Chamber of Commerce, Statewide Water Resources Committee. Summary Minutes of meeting in San Francisco, August 15, 1957.
461	California Water Development Council. "Statement of Policy." Fresno: California Water Development Council, 1957.
462	Colorado Agricultural and Mechanical College. "Report by the Campus Committee for Use by College President in Reporting to the President's Water Resources Policy Commission." Fort Collins, 1950. Pp. 7.
463	Colorado Water Conservation Board. "Colorado Water Conservancy District Law of 1937." Denver, 1943.
464	"Correspondence and Data Pertaining to 'Statement of Purpose and Concept for Timely Development of the State Authorized Feather River Project and the Proposed San Luis Unit of the Central Valley Project'," reproduced by Water Association of Kern County, Bakersfield, 1957.
465	County Supervisors Association of California. "Proposed Water Legislative Policy." Sacramento, 1954. Pp. 6.
466	Dawson, J. A. "Background Literature on Western Natural Resource Development Relating to Water Use." (Natural Resources Paper No. 2.) University of Chicago Office of Agricultural Economics Research, Paper No. 5507, September 13, 1955.
467	Dawson, J. A. "Review of the Bureau of Reclamation Analysis of the Weber Basin Project, Utah." (Natural Resources Paper No. 9.) University of Chicago Agricultural Economics Research, Paper No. 5511, September 13, 1955.
468	"Economics of Water Resources Development in the Eleven Western States; an Inventory of Research," compiled by P. L. Golton. Berkeley: Giannini Foundation of Agricultural Economics, University of California, December 1951.
469	"Economics of Water Resources Development in the Eleven Western States; an Inventory of Research, Supplement I," compiled by O. Cummings. Berkeley: Giannini Foundation of Agricultural Economics, University of California, June 1954.
470	"Economics of Water Resources Development in the Eleven Western States; an Inventory of Research, Supplement II," compiled by O. Cummings. Berkeley: Giannini Foundation of Agricultural Economics, University of California, July 1956.
471	"Feather River Plan Aid," editorial reprinted from Los Angeles Evening Herald-Express, August 15, 1957, by the Feather River Project Association, Los Angeles.
472	Feather River Project Association. "California and the San Joaquin Valley Need the Feather River Project." Los Angeles, 1957.
473	Feather River Project Association. "California Feather River Project." Los Angeles, n.d.
474	Feather River Project Association. "Financial Policy for the Feather River Project and Other State Water Projects," adopted by Board of Directors, Sacramento, August 9, 1957.
475	Feather River Project Association. "List of Ten 'Most Asked' Questions with Suggested Answers." Los Angeles: Feather River Project Association, August 6, 1957. Pp. 4.
476	Feather River Project Association. Members' Newsletter.
477	Feather River Project Association. Minutes of the Board of Directors Meeting. Los Angeles, June 14-15, 1957.
478	Feather River Project Association. Press Release, Los Angeles, August 13, 1957.

Ref. No.

479 Feather River Project Association. "Second Annual Report, June 30, 1957." Los Angeles, 1957.

480 Feather River Project Association. "What the Feather River Project Means to You." Los Angeles, 1957.

481 Green, D. S. "Federal Irrigation Subsidy." (Natural Resources Paper No. 10.) University of Chicago Office of Agricultural Economics Research, Paper No. 5601, January 11, 1956.

482 Haver, C. B. "History and Status of Federal Resource Development Activities." (Natural Resources Paper No. 4.) University of Chicago Office of Agricultural Economics Research, Paper No. 5512, September 22, 1955.

483 Haver, C. B. "Secondary Benefits." (Natural Resources Paper No. 5.) University of Chicago Office of Agricultural Economics Research, Paper No. 5513, September 23, 1955.

484 Huffman, R. E. "Economics of Irrigation Development." Bozeman, Montana, 1951. Pp. 18.

485 Irrigation Districts Association of California. "Financial Programs for Water Development." San Francisco, 1955.

486 Irrigation Districts Association of California. "Summary of 1957 Legislation of Interest to Members." San Francisco, 1957.

487 "Is This San Luis War Necessary," editorial reprinted from Los Angeles Times, April 21, 1957, by Feather River Project Association, Los Angeles.

488 Kern County Farm Bureau. Press Release, Bakersfield, September 9, 1957.

489 Kern County Farm Bureau. "Resolution of the Kern County Farm Bureau," Bakersfield. September 5, 1957. Pp. 1.

490 Kern County Farm Bureau. "Statement of Purpose and Concept for Timely Development of the State Authorized Feather River Project and the Proposed Federal San Luis Unit of the Central Valley Project." Bakersfield: Kern County Farm Bureau, 1957. Pp. 5.

491 Kings River Water Association. "Administrative Agreement: Water Right Indenture Agreement Supplementing and Amending Water Right Indenture Dated May 3, 1927 and Supplementing and Amending Administrative Agreement Dated May 3, 1927 Relating to Kings River Water Association and Monthly Diversion Schedules of Kings River Water Association." Fresno, June 1949.

492 "A Lift for State's Water Program," editorial reprinted from Mirror News, August 15, 1957, by the Feather River Project Association, Los Angeles.

493 Margolis, J. "Economic Criteria for the Allocation of the Public Budget Benefits-Costs Measurements as a Case Study." (Technical Report No. 28, prepared for Office of Naval Research.) Stanford: Stanford University Department of Economics, December 5, 1955.

494 Margolis, J. "External Economies and the Justification of Public Investment." (Technical Report No. 22, prepared for Office of Naval Research.) Stanford: Stanford University Department of Economics, October 25, 1955.

495 Metropolitan Water District of Southern California. Letter from Joseph Jensen, Chairman, Board of Directors, to Harvey O. Banks, Director of Water Resources, September 18, 1956.

496 Metropolitan Water District of Southern California. "Statement of Policy Regarding the San Luis Unit of the Proposed Feather River Project of the State of California," approved by the Board of Directors of the Metropolitan Water District of Southern California, September 18, 1956. Los Angeles, 1956. Pp. 1.

497 Metropolitan Water District of Southern California. "Statement of Policy Regarding the State Water Plan," approved by the Board of Directors of the Metropolitan Water District of Southern California, March 6, 1956. Los Angeles, 1956. Pp. 2.

498 Milliman, J. W. "The History, Organization, and Economic Problems of the Metropolitan Water District of Southern California." Unpublished Ph. D. dissertation, Department of Economics, University of California at Los Angeles, June 1956.

499 "'Monstrous' Water Litigation, 'Legal Frankenstein' (CVP, FRP, etc.)," letter from Walter M. Gleason, Attorney, to Hon. Edwin J. Regan, April 23, 1957.

Ref. No.

500 Montana State College. "Report of Montana State College Committee to the Water Resources Policy Commission." Bozeman: Montana State College, 1950. Pp. 30.

501 Mountain Counties Water Resources Association. "Proposed Constitutional Amendment on Water," memorandum to Legislative Joint Committee on Water Resources Development Problems, Senate, and Assembly, August 14, 1957.

502 National Reclamation Association. "A National Water Policy, Report of Water Policy Committee." Washington, 1952. Pp. 14.

503 National Reclamation Association, Repayment Study Committee. "Report of Repayment Study Committee." Washington, September 1954. Pp. 9.

504 New Mexico College of Agriculture and Mechanic Arts. "Report of Committee of New Mexico College of Agriculture and Mechanic Arts Concerning Questions Relating to Water Resources Policies." State College, 1950. Pp. 12.

505 Northern Colorado Water Conservancy District. Contract Form: "An Ordinance to Contract for the Purchase of Beneficial Use of Waters on Behalf of the City of ______, Colorado, a Municipal Corporation, for the Extension and Improvement of a System of Waterworks and Prescribing the Terms for Petition for an Allotment of Water to Said City by Said Northern Colorado Water Conservancy District, and Declaring an Emergency, (Class B)."

506 Northern Colorado Water Conservancy District. Contract Form: "Petition to Northern Colorado Water Conservancy District for Allotment of Water," by corporation (Section 25 contract form).

507 Northern Colorado Water Conservancy District. Contract Form: "Petition to Northern Colorado Water Conservancy District for Allotment of Water," by Irrigation Districts (Class C).

508 Northern Colorado Water Conservancy District. "Rules and Regulations for Declaration of Water Quotas and for Water Deliveries; Rules and Regulations for Reallocation and Transfer of Water Allotments." Loveland: Northern Colorado Water Conservancy District, 1956.

509 Orange County Municipal Water District. Agreement Between Orange County Municipal Water District and the City of Santa Ana, September 6, 1955 (copy).

510 Orange County Tax Collector. "1957-58 Tax Rates of Orange County, California." Santa Ana, California, 1958.

511 Orange County Water District. "Activities of the Orange County Water District," 1957.

512 Orange County Water District. "Orange County Water District Act as Amended, Effective September 11, 1957." Pp. 36.

513 "The Policy of the City and County of San Francisco Relative to the California Water Plan," January 15, 1957. Pp. 3.

514 Rasmussen, J. J. "The Issue of High Costs per Acre for Irrigation Developments Under the Upper Colorado River Basin Project," University of Utah, Economics Department, n.d. Pp. 4.

515 Rasmussen, J. J. and C. E. Nelson. "The Subsidy Issue Relative to the Colorado River Storage Project and Participating Projects," University of Utah, Economics Department, n.d. Pp. 23.

516 Renshaw, E. "The Controversy over Alternative Procedures for Ranking Water Resources Projects." (Natural Resources Paper No. 13.) University of Chicago Office of Agricultural Economics Research, Paper No. 5618, October 26, 1956.

517 Resources for the Future, Inc. "Sections Digest, Revised, Section I-VIII." Mid-Century Conference on Resources for the Future. Washington, D.C.: Resources for the Future, 1953.

518 Ribbel, A. "California's Water Problems," reprint of series in Evening Tribune, San Diego, California, 1957.

519 San Bernardino Valley Municipal Water District. Election Results--San Bernardino County Run No. 3 Water District, Special Election November 26, 1957. San Bernardino.

520 San Bernardino Valley Municipal Water District. "Statement of Facts and Policy Concerning the Annexation of San Bernardino Valley Municipal Water District to the Metropolitan Water District of Southern California." San Bernardino, 1957.

521 San Diego Chamber of Commerce. Minutes of the Meeting of the Water Committee, August 26, 1957.

Ref. No.

522 Shafter-Wasco Irrigation District. "Feasibility Report by the Advisory Committee." Shafter, March 1948.

523 Shafter-Wasco Irrigation District. Sample contract between Shafter-Wasco Irrigation District and Landowner; Tentative Rules and Regulations, 1957.

524 Shafter-Wasco Irrigation District. "Shafter-Wasco Irrigation District," 1957. Pp. 7.

525 Southern California Water Coordinating Conference. "Recommended Funds and Accounts to Supplement Statement of Principles for Statewide Water Development." Los Angeles April 2, 1957.

526 Southern California Water Coordinating Conference. "Statement of Principles for State-Wide Water Development." Los Angeles, n.d.

527 Stanford Research Institute. "Selected Bibliography on Water Resources." Menlo Park: Stanford Research Institute, May 26, 1955.

528 Stanford University Group. "Report on Water Resources Policy to the President's Water Resources Policy Commission." Stanford, May 1950.

529 State College of Washington, Department of Agricultural Economics. "Statements Prepared for U. S. President's Water Resources Policy Commission." Pullman: State College of Washington, 1950.

530 Stivers, T. P. "Financial Problems Concerning Irrigation and Water Districts." San Francisco: California Districts Securities Commission, September 1957.

531 "Suggested Explanatory Statement to Set Forth the Position of Southern California before the 18-Man Committee of the Legislature in Los Angeles, November 19," 1957.

Ref. No.

532 Syracuse University, Maxwell Graduate School. "Tentative Study Plan, Delaware Valley Project." Syracuse: Syracuse University, September 3, 1957.

533 Tax Foundation. "Project Note 33: Our Water Resources; the Need for a Unified National Policy." New York: Tax Foundation, 1953. Pp. 32.

534 University of California. "Salt Water Conversion Research Program," paper prepared by E. D. Howe. Berkeley: University of California, Division of Mechanical Engineering, November 11, 1957. Pp. 9.

535 "Water," a special editorial report, Power, September 1952.

536 Water Association of Kern County. "Water Crisis." Bakersfield, 1956.

537 "A Water Creed for All California," editorial reprinted from Los Angeles Times, February 15, 1957, by the Feather River Project Association, Los Angeles.

538 "Water Solution Needs Goodwill," editorial reprinted from Mirror News, January 11, 1957, by the Feather River Project Association, Los Angeles.

539 Western Water News.

540 "Where Do We Go From Here?" editorial reprinted from Los Angeles Times, June 11, 1957, by the Feather River Project Association, Los Angeles.

541 White, M. "Our Great Water Problem," reprinted from the Los Angeles Examiner, January 23, 24, 29 and February 17, 18, 19, 20, 21, 22, 24, 1957.

542 "Word of Warning," reprinted from The Sacramento Union, April 26, 1957, by the Feather River Project Association.

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